American Nuclear Society

MINUTES

Risk-Informed, Performance-Based Principles and Policy Committee (RP3C)
Marriott Philadelphia Downtown
June 18, 2018

Members Present:
N. Prasad Kadambi, RP3C Chair, Individual
*Edward Wallace, Vice-Chair, GNBC Associates, Inc.
John Fabian, (Secretary Pro Tem), American Nuclear Society
*Patricia Schroeder (Secretary), American Nuclear Society
*Todd Anselmi, Enercon Services, Inc.
*James August, Southern Company
*Robert Budnitz, Lawrence Berkeley National Laboratory
Nilesh Chokshi, Individual
*George Flanagan, Oak Ridge National Laboratory
*Kathryn Hanson, Individual
David Hillyer, Energy Solutions
*Alan Levin, U.S. Department of Energy
Stanley Levinson, Individual
*Mark Linn, Oak Ridge National Laboratory
*Thomas Marenchin, U.S. Nuclear Regulatory Commission
*Shivani Mehta, U.S. Nuclear Regulatory Commission
*William Reckley, U.S. Nuclear Regulatory Commission
*William Reuland, Individual
Ruth Weiner, AECOM
*Robert Youngblood, Idaho National Laboratory

Guests:
Steven Arndt, U.S. Nuclear Regulatory Commission
Donald Eggett, Individual
Ronald Knief, Sandia National Laboratories
Zachary Jankowsky, Sandia National Laboratories
*Steven Stamm, Individual
Larry Wetzel, BWXT, Inc.

**participated by phone*

1. **Welcome, Roll Call & Introductions**
RP3C Chair Prasad Kadambi called the meeting to order. Those physically in attendance and those on the phone introduced themselves.

2. **Approval of Meeting Agenda**
A presentation was provided to members in advance of the meeting for use throughout the meeting by Prasad Kadambi – See Attachment 1. He asked members to allow him the flexibility to move items around as needed. Main themes since the last meeting are that they have been working with particular standards and have learned a lot about risk informing a variety of technical areas. It is very important to get back to the basics to communicate and realize the benefit of the whole risk-informed and/or performance-based (RIPB) approach. Kadambi stated that industry is recognizing the benefit of RIPB,

and he feels ANS has a big opportunity. It is very important for the American Nuclear Society (ANS) to take a leadership role.

3. Status and Follow-up from Standards Board Meeting

A. Outcome of Standards Board Meeting on October 30, 2017
The Standards Board has tasked the RP3C to train working groups how to incorporate RIPB methods into ANS standards.

B. RP3C Actions on Standards Committee Strategic Plan Goals & Objectives
(Attachments: 2A Strategic Plan — 2B SMART Matrix — 2C RP3C SMART Matrix)
Attachments 1 A-C were reviewed. Prasad Kadambi explained that the matrix platform insures that tasks are actionable and feasible. He prepared a sample format for RP3C to use.

C. Status of RP3C Operating Plan (Attachment 3)
Kadambi reported that the RP3C Operating Plan is essentially complete but needs to set timeframes. He hopes to have a better sense after today's meeting. The operating plan is part of a dynamic process under the Standards Board. The categorization, Section 2.1.1 of the operating plan, has been completed by a small group of RP3C members. They are now focusing on the balance of the plan to develop the guidance. A few standards are being used as pilots to see how incorporating one or more RIPB principles will benefit the standard. They are working directly with working groups to incorporate methods. Kadambi recognized that the industry is focusing on advanced reactors.

Ed Wallace clarified that the small group of RP3C members that evaluated ANS standards for benefit of incorporating RIPB principles worked off of a spreadsheet with a list of 400 plus projects (inactive and active) and standards (current and withdrawn) of which the evaluation was limited to 123 current standards and active projects. Wallace speculated that there could be benefit to developing some of the inactive projects and/or withdrawn standards with RIPB methods and should be considered at a later time.

Kadambi offered himself as a contact for any committee in need of guidance to incorporate RIPB methods. Invitations were extended for Kadambi to attend consensus committee meetings and for committee members to attend RP3C meetings. Pat Schroeder will provide Kadambi and Wallace details for the next FWDCC call so that they may participate.

ACTION ITEM 6/2018-01: Pat Schroeder to provided Prasad Kadambi and Ed Wallace call in details for the next FWDCC teleconference. DUE DATE: June 30, 2018

D. Status of Procedural Guidance (Attachment 4)
- Pilots and example standards
- Challenges encountered

Kadambi reported that he had hoped to use NFPA 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," as a reference for the procedural guidance document, but it didn't work well. The standard did not validate performance-based concepts regarding outcomes.

The RP3C task group has also looked at several ANS standards including the following:

- ANSI/ANS-2.3-2011 (R2016), "Estimating Tornado, Hurricane, and Extreme Straight Line Wind Characteristics at Nuclear Facility Sites"
- ANSI/ANS-2.8-1992 (W2002), "Determining Design Basis Flooding at Power Reactor Sites"

- ANSI/ANS-2.21-2012 (R2016), "Criteria for Assessing Atmospheric Effects on the Ultimate Heat Sink"
- ANSI/ANS-2.26-2004 (R2017), "Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design"

The previous approach of prescribing requirements makes it difficult to take account of changing conditions and circumstances. Wallace added that there is another component. You can't just do performance based as successfully as you like because you lose risk significance. You need to get the context set properly provided they have the conditions the standard should be evoked. You will not get a robust outcome without looking at whether or not it is a rare event and how it applies in a performance-based, decision-making format. Characterization needs to be directional for flexibility. Wallace added that RP3C needs to have offline discussion on how to get this across to working groups.

4. Changing Environment

A. U.S. Nuclear Regulatory Commission (NRC) Commission Briefing on Advanced Reactors, April 24, 2018
A Commission briefing on advanced reactors was held on April 24, 2018. NRC staff is aiming for regulatory practices that are flexible, staged, and predictable.

B. Licensing Modernization Project
Trends from the regulatory arena are to focus on outcomes. The licensing modernization project (LMP) is developing a RIPB approach for identification of licensing-basis event; probabilistic risk assessment approach; classification of structures, systems, and components; and defense-in-depth. The LMP sets the stage for doing things differently. Work on JCNRM is essential to understanding probabilistic risk assessment, particularly for advanced reactor designs. The use of RIPB principles and guidance will allow a standard to be applied to different technologies and different sized reactors.

C. NRC's Transformation Program
SECY-18-0060 has gone to the Commission in the last week to transfer the review process using risk insights to scale scope and depth of review. The paper calls for rulemaking for advanced reactors in a philosophical Part 53 which should be performance based and technology inclusive. Steven Arndt clarified that the paper is a big deal and could have significance for standards. NRC is seriously talking about changing the Standards Review Plan (SRP) using risk-insights in a formalized way. Not only is it non technology specific, it goes out of its way to encourage alternate technologies. It is not specific intentionally. The term "risk" is used in two different concepts—insights to the likelihood of occurrence and terminology of risk with decision making. With respect to new technology, they are specifically talking about the concept of alternative means intended to be generalized as a higher concept. Arndt added that we will need to address in ANS standards when we know how much will be incorporated as a procedural process versus changes to guidance documents. More will be known in a few months. Arndt expected the need to schedule a mid-term Standards Board call to layout the direction ANS standards need to take. Kadambi sees plenty of opportunities for performance-based approaches.

D. ANS/NRC Advanced Reactors Standards Workshop (Attachment 5)
Kadambi reminded members that an ANS/NRC workshop was held in May to discuss advanced reactor standards needs. The input from workshop participants was that they are not waiting for standards to be written; standards are not an impediment but that they would be helpful. Workshop participants expressed clear preference for risk-informed and performance-based standards.

E. ANS Public Policy Committee and Position Statements
Kadambi informed members that ANS Position Statement 46 was issued last year favoring RIPB. A new position paper is in development on advanced reactors. Kadambi is on the ANS Public Policy Committee and will keep the RP3C and the Standards Board informed as appropriate.

5. Benchmarks for RIPB Safety Approach

A. NRC-1999 → White Paper on RIPB (Attachment 6)
- Importance of Terminology
- Clarifying Attributes from Definitions

Every standard that employs risk-informed approach should test outcome for these attributes. Every use of performance-based approaches should test for these outcome attributes.

B. NRC-2018 → Commission Paper on Functional Containment
- Focus on Function and Purpose

A SECY paper on functional containment has been approved by the Commission and has been or will be issued shortly. The paper endorses the LMP. The Standard Review Plan will be moving to a more RIPB approach. The implications for standards are that we should be capturing the progress made in the LMP.

C. ANS-2018 → Integrated Approach to Graded Safety, Avoiding Unnecessary Requirements
- Integrated Approach → Observations (Inspection, Testing) Support Performance
- Graded Safety → PRA Supports Safety Significance Determination
- Requirements → Performance Observations Determine Need

RIPB implementation should focus on most important activities, objective criteria regarding performance, measureable or calculable (observable) parameters to monitor performance, flexibility in meeting performance criteria to encourage and reward improved outcomes, and results for safety decision-making.

6. Review of Interaction with Standards Working Groups (Attachment 6)

A. ANS-51.10, "Auxiliary Feedwater System for Pressurized Water Reactors"
Ed Wallace shared observations when draft standard ANS-51.10-201x, "Auxiliary Feedwater System for Pressurized Water Reactors," was reviewed. He felt that the draft standard specifically excludes requirements for RIPB inclusion; however, positively recognizes the potential for added value by implementing organization use of RIPB practices. Minor modifications to wording would improve the performance-based utility of the standard. It could also be modified to suit advanced reactors with minimal change. More details are provided in the meeting presentation (Attachment 1, slides 31-35).

Members questioned the stage ANS-51.10 draft standard is at and whether the comments were shared with the working group. Steven Stamm explained that the draft standard had already been through ballot and was resolving comments. Changes at this time would likely put an end to work on the revision. Prasad Kadambi explained that the purpose of this review and discussion is to determine the type of guidance needed to provide working groups at the right time in the evolution. George Flanagan acknowledged the unwillingness from the industry for change even if it makes it better. Wallace added that he understands industry's reservation but feels application to future plants would be welcomed.

B. ANS-58.8, "Time Response Design Criteria for Safety-Related Operator Actions"
Kadambi reported that he has been working with the ANS-58.8 Working Group and attended a recent group teleconference. He added that this is the type of interaction that is needed and that the RP3C needs to commit more resources to this type of exchange. Stamm stated that the group did not get the type of comments back that they expected. Kadambi clarified that he did not find the standard performance based but needs more time to provide guidance. Kadambi will follow up with

the working group. Stamm added that the ANS-58.8 Working Group is finalizing a draft and that it would be difficult to make a lot of changes at this time.

C. ANS-2.26, "Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design"
Time did not permit discussion of ANS-2.26.

D. ASME Boiler Pressure and Vessel Code (BPVC) Sec. III, Div. 5, "High Temperature Materials"
Kadambi explained that ASME Sec. III, Div. 5, was a topic at the ANS/NRC Advanced Standards Needs Workshop held last month. The working group chair was at the workshop and is open to making this section more performance based. ASME International is also working to incorporate RIPB in the Operation and Maintenance Code and Section XI of the BPVC.

E. Other Standards (e.g. ANS-30.3, "Advanced Light-Water Reactor Risk-Informed Performance-Based Design Criteria and Methods")
Time did not permit discussion of ANS-30.3.

F. Inputs from LLWRCC, RARCC, NCSCC, FWDCC, NRNFCC
FWDCC standards were discussed elsewhere. Flanagan provided an update of RARCC projects. He believes that ANS-30.2, "Categorization and Classification of Structures, Systems, and Components for New Nuclear Power Plants," would be making good use of the LMP. ANS-54.1, "Nuclear Safety Criteria and Design Process for Liquid-Sodium Cooled-Reactor Nuclear Power Plants," was issued for ballot and currently resolving comments. ANS-20.1, "Nuclear Safety Design Criteria for Fluoride Salt-Cooled High-Temperature Reactor Nuclear Power Plants," and ANS-20.2, "Nuclear Safety Design Criteria and Functional Performance Requirements for Liquid-Fuel Molten Salt-Reactor Nuclear Power Plants," would follow ANS-54.1. ANS-30.1, "Integrating Risk and Performance Objectives into New Reactor Nuclear Safety Designs," is turning out to be more of a process standard. Flanagan was not sure if the scope is purely RIPB.

Stamm added that he sat in on a working group meeting on Sunday that he believes needs an interface with RP3C—ANS-3.15 on cybersecurity. He believes that this is an appropriate stage for RP3C to get involved as they are working on the Project Initiation Notification System (PINS) form.

Stamm questioned if the operating plan Kadambi referred to is the same as the "ANS Risk-Informed and Performance-Based Standards Plan" directed by the RP3C Bylaws. If intended to be what the RP3C Bylaws calls for, he felt that the same terminology should be used. Kadambi will review the RP3C Bylaws and make sure all is consistent. He will either change the name of the operating plan or recommend that the term used in the RP3C Bylaws be changed.

ACTION ITEM 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: July 15, 2018

Kadambi reiterated that the operating plan is complete but needs feedback from users to establish timeframes. It was confirmed that consensus committee chairs were assigned an action at the last Standards Board meeting to report back to the Standards Board and RP3C on RP3C's recommendations.

7. RP3C Report to Standards Board

A. RP3C Operating Plan Status
RP3C is making progress relative to the operating plan and will be implementing an RP3C SMART matrix and will work on a schedule.

B. RP3C Pilot Activities

Many lessons were learned from dealing with different standards. Going back to basics on RIPB will be very help as will documents being prepared as part of the LMP and by the NRC. Much support for use of RIPB principles is coming from the industry and from the NRC. The RP3C will be recommending this focus to the Standards Board.

8. Review of Open Action Items

The RP3C has two open action items from previous meetings. The action items and their status are provided below:

10/2017-01: Prasad Kadambi to present the RP3C Categorization of ANS Standards to the Standards Board for their endorsement with the following proposed actions:

1) for each consensus committee to review, evaluate, and set a priority list
2) for each consensus committee chair, or chair appointee, to serve as a point of contact to the RP3C
3) for each consensus committee's point of contact to provide committee feedback to RP3C
4) for RP3C to update the categorization list with committee feedback

STATUS: Recommendation made and accepted. An action item was assigned at the last Standards Board meeting for consensus committee chairs to address.

11/2016-11: RP3C to prepare a brief, five-slide presentation with a simple perspective explaining RIPB for use at consensus committee meetings.

STATUS: Open

9. Other Business

Time did not permit discussion of other business.

10. Next Meeting

The RP3C plans to meet at its set time on Monday from 2:30 p.m. to 6:00 p.m. during the ANS Winter Meeting to be held November 11-15, 2018, Orlando, FL, as well as during the ANS Annual Meeting, June 9-13, 2019, Minneapolis, MN.

11. Adjournment

The meeting was adjourned.

RP3C Open Action Items and Those Closed at the June 2018 Meeting

Action Item	Description	Responsibility	Status/Action
6/2018-01	ACTION ITEM 6/2018-01: Pat Schroeder to provided Prasad Kadambi and Ed Wallace call in details for the next FWDCC teleconference. DUE DATE: June 30, 2018	Pat Schroeder	OPEN
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: July 15, 2018	Prasad Kadambi	OPEN
10/2017-01	Prasad Kadambi to present the RP3C Categorization of ANS Standards to the Standards Board for their endorsement with the following proposed actions: 1) for each consensus committee to review, evaluate, and set a priority list 2) for each consensus committee chair, or chair appointee, to serve as a point of contact to the RP3C 3) for each consensus committee's point of contact to provide committee feedback to RP3C 4) for RP3C to update the categorization list with committee feedback	Prasad Kadambi	CLOSED Recommendation made and accepted. An action item was assigned at the last Standards Board meeting for consensus committee chairs to address.
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	OPEN

ATTACHMENT 1

ANS Standards Committee RP3C Meeting

Philadelphia, PA

June 18, 2018

Agenda

- Welcome, Roll Call & Introductions
- Approval of Meeting Agenda
- Status and Follow-up from Standards Board (SB) Meeting
  - SB Meeting of October 30, 2017
  - Strategic Plan flow down from ANS to SB to RP3C
  - RP3C Operating Plan
  - RP3C Procedural Guidance
- Changing Environment
  - NRC Initiatives
  - Industry Initiatives
  - SDO Initiatives (ANS and Others)
- Benchmarks for RIPB Safety Approaches
  - NRC-1999
  - NRC-2018
  - ANS-2018
- Review of Interaction with Working Groups
  - Review of work with specific standards and obtain feedback
  - Inputs from Consensus Committees
- RP3C Report to SB
  - Status of Planning Activities
  - Status of Pilot Activities
- Open Items & Action Items
- Other Business
- Next Meeting, Adjournment
  - ANS Winter Meeting, November 11-15, 2018, Orlando, FL
  - ANS Annual Meeting, June 9-13, 2019, Minneapolis, MNhttps://www.earlystownmanor.com/

SB Meeting of Oct 2017

See Attachment 1A

- Incorporate RIPB principles into ANS standards where appropriate
- This is part of Goal #1 of the ANS Standards Committee Strategic Plan
- The outcome objective is to conduct training of consensus committees (CC) and working groups (WG)

SB Meeting of Oct 2017

See Attachment 1B

- Develop the RP3C Operating Plan
- Develop a RIPB Principles training package for training of ANS Standards Committee members
- Conduct training of consensus committees (CC) and working groups (WG)

SMART Matrix June 2018

See Attachment 1C

- Six objectives of Strategic Plan translate to eight activities by RP3C
- First of these is the RP3C Operating Plan, which is complete in terms of steps toward goals, but incomplete regarding schedule of performance
- For purposes of the planning process, it is complete for now
- This is a recognition that the RP3C Operating Plan is part of a dynamic process under the supervision of the ANS Standards Board
- Consideration of updated RP3C Op. Plan

RP3C's SMART Matrix

RP3C Activity	Specific	Measurable	Attainable	Resources	Time
Activity 1					
Activity 2					
Activity 3					
Activity 4					
Activity 5					
Activity 6					
Activity 7					
Activity 8					

Updated RP3C Operating Plan

See Attachment 2

- Item 2.1 is to develop a RIPB guide for the ANS Standards Committee
  - Begins with categorization of ANS standards and projects, which was done and presented to the SB
  - Although some refinement has occurred no significant change has happened
- Item 2.1.2 is to develop guidance
  - RP3C activity between November 2017 and June 2018 has been in this area
  - Focus has been on examples
  - Wide range of examples were considered and some will be discussed at this meeting
- Further evolution of RP3C Operating Plan awaits sufficient consensus on basic elements of RIPB guidance

Categorization of ANS Standards

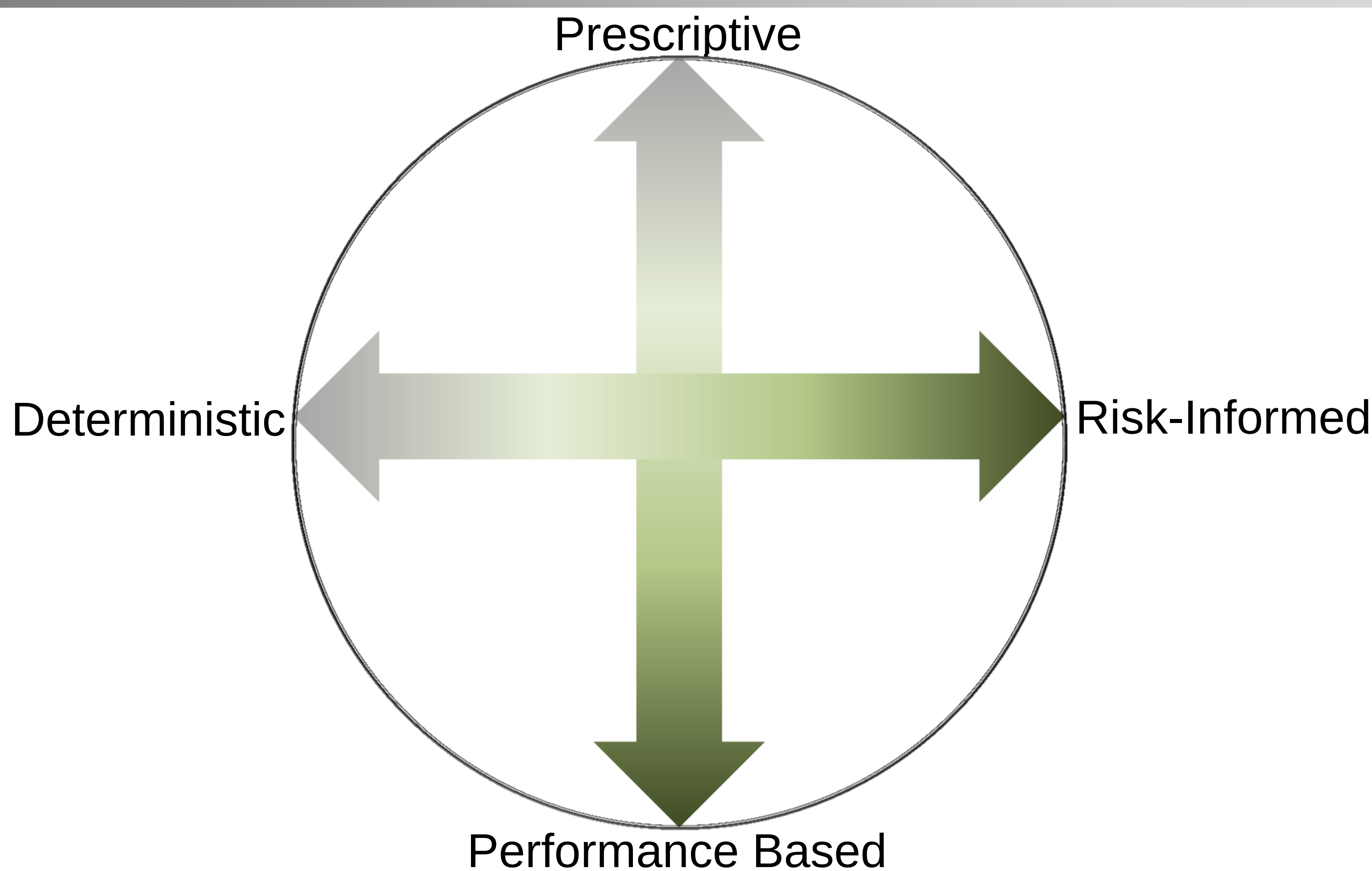
	CC Owner	DESIGNATION		TITLE	STATUS	Status Indicator	RP3C Opportunity				Applicability				
							RIPB	RI	PB	D	Adv Rx focus	AR applicability	Likely Timing of Need*	NT- <3 yrs MT 3-5 yrs LT >5 yrs	
9	ESCC	ANS-	28	Determining Design Basis Flooding at Power Reactor Sites	withdrawn standard; active project	P		AEJ							3
27	ESCC	ANS-	226	Categorization of Nuclear Facility Structures, Systems, and Components For Seismic Design	current standard approved 2004 (R2010)	A	AE	J							2
28	ESCC	ANS-	227	Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments	current standard approved 2008 (R2016)	A	AJE								3
35	LLWRCC	ANS-	31	Selection, Qualification, and Training of Personnel for Nuclear Power Plants	current standard approved 2014	A				AEJ					3
36	LLWRCC	ANS-	32	Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants	current standard approved 2012	A	JE			A					2
62	LLWRCC	ANS-	313	Nuclear Facility Reliability Assurance Program (RAP) Development	active project	A	AEJ								3
63	NRNFCC	ANS-	314	Process for Aging Management and Life Extension for Nonreactor Nuclear Facilities	active project	A	AEJ								3
206	LLWRCC	ANS-	181	Radioactive Source Term for Normal Operation of Light Water Reactors	revision approved 2016	A				AEJ					3
280	LLWRCC	ANS-	5110	Auxiliary Feedwater System for Pressurized Water Reactors	current standard approved in 1991 (R2008); revision in development	A	E		AJ						2
288	RARCC	ANS-	531	Nuclear Safety Design Process for Modular Helium-Cooled Reactor Plants	current standard approved 2011 (R2016)	A	AEJ								3
313	RARCC	ANS-	541	Nuclear Safety Criteria and Design Process for Liquid-Sodium-Cooled-Reactor NPPs	active project; historical revision	P	AEJ								3
318	RARCC	ANS-	546	LMFBR Safety Classification and Related Requirements	inactive project; draft issued for trial use only	I	J								3
334	LLWRCC	ANS-	561	Containment Hydrogen Control	active project	P	AE		J						2

ANS Standards Evaluation for RIPB Applications

- Preliminary screening results of 123 active standards or projects:
  - RIPB – 15
  - RI – 3
  - PB – 8
  - Leave as is – 42
  - Still under discussion – 55*
- Used for advanced reactor development:
  - Near term – TBD
  - Mid term – TBD
  - Long term – TBD

* Further task team consensus reconciliation needed

Regulatory Approaches



Core Principles & Policies for Incorporation into Guidance

See Attachment 3

- Importance of considering the outcome
  - Framing the "what" and "how"
  - NFPA-805 experience does not appear to validate PB concepts regarding outcomes
- Relationship between probabilistic formulation and "risk-informed"
  - Consideration of external hazards (ANS-2.3, 2.8, 2.21, 2.26)
- Consideration in standards given to design-basis and beyond-design basis
  - ANS-2.26 ⇔ ASCE 43-05
  - ANS-51.10, ANS-58.8

ANS-58.8

"Time Response Design Criteria for Safety-Related Operator Actions"

- **Outcome:** Approved standard to justify operator actions to perform safety-related actions versus requirement for automatic action
- **Relevance:** Advanced reactors generally have plenty of **"margin"** so expensive safety-grade automatic action can be avoided
- **Performance-based feature:** Parameters and decision thresholds affecting operator actions with specified **"margins"**. Focus on functional success.
- **Possible Risk-informed feature:** Include requirement to estimate radiological consequence if margin is violated. PRA used for hypothesis testing.
- **Possible non-RIPB feature:** Avoid human factors analysis by specifying **"margin"** for deterministic safety case.

NRC Benchmark Performance-Based Safety

- Performance-Based Approach
  - Measurable or calculable (observable) parameters to monitor performance
  - Objective criteria to assess performance
  - Flexibility in meeting performance criteria to encourage and reward improved outcomes
  - Framework for failure to meet a performance criterion; will not constitute in immediate safety concern
- Every use of PB approach should test for these outcome attributes

"Outcomes" versus "Outputs"

- Purpose and intention of **activity** are important for **"performance"**
- Observations of results produced by **"performance"** is basis for assessing **"effectiveness"**
  - Granular as well as aggregated observations offer evidence of **"effectiveness"**
- The direct and immediate result of an **activity** may not accomplish the intended purpose
  - Example: Knob tweaking moves a needle. Is that the result sought?
  - Needle movement is the **"output"**. Observation of system implication is **"outcome"**
  - Intended purpose generally reflected by a change of system state
- Distinguishing **"output"** from **"outcome"** implies a hierarchical structure within the **activity**.

Assuring Performance at Different Levels of the Hierarchy

Level	Examples of Existing Requirements	PB Monitoring
Plant Protection		Time-dependent conditional probability of core damage
Function		Rate of loss of function; functional unavailability
System	LCO on multiple train inoperability (certain systems)	System outage rate; system unavailability
Train	Tech Spec AOTs	Train outage rate; train unavailability
Component	QA; IST, ISI; Calibrations; Surveillances	Component failure rates, unavailabilities, performance trending
Human Actions	Qualifications, Training,	Qualifications, Training,
Programs	Implementation of ISI, IST, Maintenance Rule,	Implementation of ISI, IST, Maintenance Rule,
Institutional Factors	??	??

Regulatory Trends
Focus on Outcomes

- NRC expectations on outcomes of reviews will be PB
  - Standards can help by making industry submittals PB
- Key NRC documents have relevance to standards
  - LMP work leading to RG
  - Functional Containment paper
  - Transformation paper
- Standards that reflect RIPB practices will support AR and align with NRC expectations
  - Work with LMP products
- ANS has opportunity to lead other SDOs
  - Need to follow through on activities related to Standards Forum and Workshop on AR

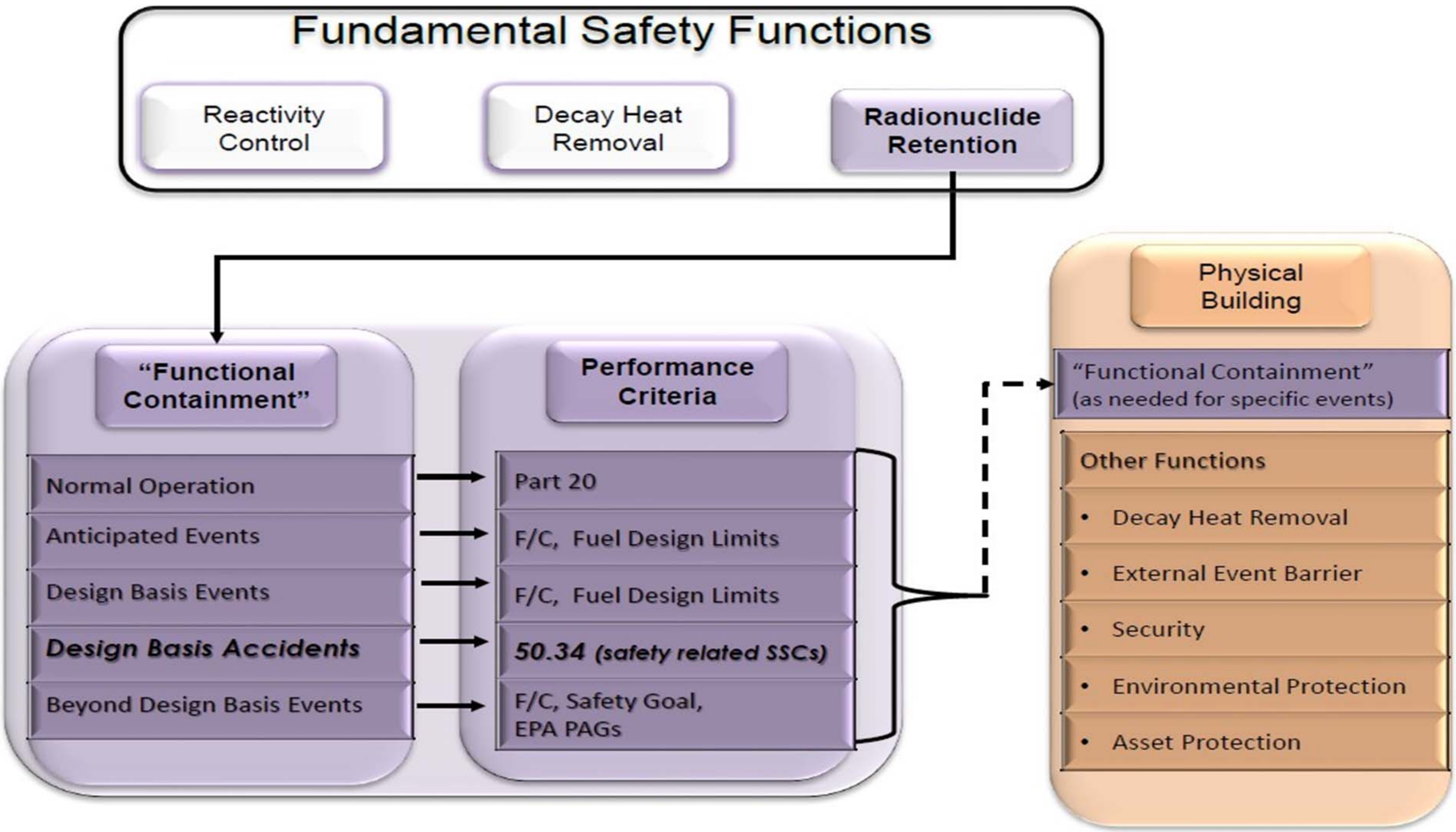
Licensing Modernization Project

- Developing a risk-informed, and performance-based approach
  - Identification of licensing-basis events
  - Probabilistic risk assessment approach
  - Classification of structures, systems, and components
  - Defense-in-depth
- Every ANS standard is likely to involve one or more LBEs
- JCNRM work needs to become part of every CC
- Progress needed on ANS-30.1, 30.2, and 30.3
- Technology specific standards need to align with and not repeat generic process in ANS-30.x series
- Treatment of defense-in-depth in ANS-2.26 can reflect recent work

SECY on Functional Containment

- Reduce prescription in favor of design objectives and performance standards
- Focus on functional performance for the purpose of radionuclide retention
- White Paper on RIPB and NUREG/BR-0303 offered as references
- Provides integrated and technology-inclusive approach for determining appropriate performance measures.
- Completeness for adequate safety finding supported by “Reactivity Control” and “Decay Heat Removal” in addition to focus on “Radionuclide Retention”

Structured Performance Model



“Risk-informed” ⇔ “Performance-based”

- Risk information is one of the products of constructing and analyzing a PRA
- Clarity in defining outcomes is a result of building a structured model for performance objectives required for **performance-based** approach
- RI and PB involve **modeling and simulation**.
  - RI is generally plant level, while PB can be component, system, function or organization level.
- PRA is **modeling and simulation** considering component failures aggregated over a whole plant scale
- **Modeling and simulation** of performance can be used to characterize performance **“margin”** available to performance objectives given a design/concept of operations.
- R&D and operational data support level of **“assurance”** or confidence for successful regulatory scrutiny.

Integrated Regulatory Review

Key Review Considerations

Safety-significance	Regulatory compliance	Novel design	Shared structures, systems, and components	Licensing approach

Safety margin	Defense-in-depth	Operational programs	Impact on safety functions	Additional risk insights	Other considerations

Review Tool

Output:
Scope and Depth of Review

- Provide supplemental approaches for implementation of NUREG-0800, Introduction - Part 2 and Design Specific Review Standard reviews
- Systematic thought process applicable to non-structure, system, or component and programmatic reviews

Implications for Standards

- A standard needs to anticipate where and how it fits into a flexible and staged permitting process
- PB design criteria need not mimic 10CFR Part 50 App. A
  - PDCs and FDCs relate under a performance structure
  - ANS CCs need to develop performance model for their standards
- Capitalize on progress being achieved under Licensing Modernization Project

Structured Performance Model
"Standards Application Platform"

- Motivation for **"performance-based"** is for combination of flexibility and accountability with **"effectiveness"** for intended purpose.
- Prior to development of formal PB methods, **prescription** and **compliance** were thought to be essential for enforcement of requirements.
- Structured performance model with appropriate oversight can assure conformance with **performance-based** requirements that serve **fitness for purpose**.
- Key to implementation is **"margin"**
- In SRM-SECY-1998-0144, Commission included incentivization for improved outcomes by encouraging and rewarding good performance

Adv Rx Commission Briefing April 24, 2018

Modernizing the Licensing Approach

- Flexible, staged, and predictable processes
- Advanced Reactors Design Criteria
- Developing a risk-informed, and performance-based approach
  - Identification of licensing-basis events
  - Probabilistic risk assessment approach
  - Classification of structures, systems, and components
  - Defense-in-depth

NRC's Transformation Program SECY-18-0060

- Transform review process
  - Use risk insights to scale scope and depth of review
  - Consider safety benefits when taking account of uncertainty of new technologies
  - Leverage operating experience, third-party approvals, and consensus standards
  - Use tools to facilitate timely decision making
- Advanced reactors
  - Initiate PB-TI rulemaking

Adv Rx Standards Workshop May 2, 2018

- Availability of standards is not a requirement for developing advanced reactors. It is an aid.
- New standards development
  - High Assay LEU fuel transportation/ storage
  - Safety significance based classification of SSC within NQA-1
- Is there a preference across the advanced reactor industry that future advanced reactor standards be more performance based and use high-level, risk-informed principles compared to current standards? What should drive this decision?
- Clear consensus in the affirmative

ANS Positions on RIPB

- Position Statement 46, “RIPB Regulations for NPP”
  - PB assures necessary flexibility
  - Consider integrated safety outcomes
  - Necessary R&D is done
- Draft PS-35, “Advanced Reactors”
  - Improved safety and economics with flexibility
  - Lower capital and operating costs
  - Fewer unnecessary requirements

NRC Benchmark Risk-Informed Safety

- Risk-Informed Approach
  - Explicit consideration of a broader set of challenges
  - Logical means for prioritizing challenges
  - Consideration of broader set of resources
  - Identify and quantify sources of uncertainty
  - Better decision-making by testing for sensitivity
- Every standard that employs RI approach should test outcome for these attributes

NRC Benchmark Performance-Based Safety

- Performance-Based Approach
  - Measurable or calculable (observable) parameters to monitor performance
  - Objective criteria to assess performance
  - Flexibility in meeting performance criteria to encourage and reward improved outcomes
  - Framework for failure to meet a performance criterion; will not constitute in immediate safety concern
- Every use of PB approach should test for these outcome attributes

NRC Benchmark RIPB Safety

- RIPB Approach
  - Focus attention on the most important activities
  - Objective criteria regarding performance
  - Measurable or calculable (observable) parameters to monitor performance
  - Flexibility in meeting performance criteria to encourage and reward improved outcomes
  - Focus on results for safety decision-making
- RIPB implementation should test for these attributes

ANSI/ANS-51.10-201x Auxiliary Feedwater System For Pressurized Water Reactors

RP3C Specific Review Observations

- Standard specifically excludes requirements for RIPB inclusion however, positively recognizes the potential for added value by implementing organization use of RIPB practices.
- There are numerous examples of essentially PB statements in the standard. Minor modifications to wording would improve the PB utility of the standard.
- There are numerous references to event conditions for AFW functions and service delivery that may benefit from a shaper focus on the link between the function purpose and the underlying event conditions and risk (safety) significance.
- There is little or no differentiation of the source event conditions and resulting AFW system performance that allows graded special treatment to be developed. This could lead to overburdening the design, manufacturing and/or operational programs associated with individual AFW SSCs.

ANS-51.10 -- Incorporating PB Considerations

3 System Functions

- "The AFS shall operate for all Plant Condition (PC) 2, 3, 4 and 5 events where main feedwater supplies are not available and the steam generators are used to mitigate the event."
  - Observation: Prescriptive Plant conditions could be restated in terms of RI practices. No indication of what is the limiting condition or what design conditions are required for safety or risk or defense in depth. PB statement provides could offer guidance on how to demonstrate/monitor the satisfaction of the requirement.
- "The AFS may also require the capability to isolate flow to a steam generator to prevent steam generator overfill or in response to a steam generator tube rupture."
  - Observation: Clear indication could be offered of when either of two different outcomes may be needed, what specific outcomes are desired. No indication of safety significance. Prescriptive Plant conditions could be restated in terms of RI practices which would aid in SSC design and special treatment decisions.

5.1.1.1 Minimum Flow

- "minimum recirculation flow is the flow required to ensure AFS pump operability when the delivered flow is zero"
  - Observation: Clear, measurable and monitorable PB statement

ANS-51.10 -- Incorporating RIPB Considerations

"5.1.1.1 Minimum Flow…

(B)…and the most limiting plant transient conditions where reliance on auxiliary feedwater flow is necessary for core protection.

These transient conditions include:

(1) Loss of main feedwater flow.
(2) Loss of offsite power.
(3) Postulated Pipe Ruptures.
(4) Station blackout.
(5) Cooldown following the preceding transients;
   - Observations – the limited set of prescriptive event conditions may not reflect the total set of limiting events for the design. A risk-informed process may expose other events that combine consider common causes or effects that go beyond these limited examples (e.g. TMI-2 accident scenario). Further, the events listed include AOOs, DBEs and BDBEs. There is no differentiation of the different flow requirements and whether other DID features in the plant compensate for the AFW under or non-performance, an important consideration in safety classification and special treatment decisions.

ANS-51.10 -- Incorporating RIPB Considerations

"5.1.1.2 Maximum Flow…

In certain scenarios, excessive AFS flow may have adverse effects on the plant response. AFS flow should be limited to a faulted steam generator to avoid excessive cooldown of the primary reactor coolant. In addition, AFS flow must be controlled to manage steam generator water level to avoid an overfill condition, which would introduce water into the steam lines challenging their integrity."

- Observations – Similar to Minimum flow, however, there is neither a list of events to be consider as in the case of the minimum flow requirements nor a general directive on how to determine the range of event scenarios to be considered in establishing the maximum flow conditions.

ANS-51.10 – Other Observations

- PRA not mentioned in the body. In general, focusing on the PRA instead of RIPB as a more balanced and complementary objective is preferable
- Many of the PB statement opportunities, if recognized as such, would enable the existing PB guidance to help define the types of statements needed and establish more safety focused SSC special treatments for subparts of the AFW system.
- The roles of AFW for DID are …
  - Help define ST for the conditions in BDBE and not extend them into the DB
  - Don’t seem to differentiate functions from risk-significance, DID and normal ops/AOO conditions
- Many advanced reactors will be attached to a Rankin steam cycle and have similar functionality. A technology neutral RIPB version of this standard should be developed

ASME Sec. III, Div. 5
High Temperature Materials

- Developers have stressed need for this standard
- It appears to move toward less prescription
  - Additional data or new materials may fit within same rules
  - More flexible "optimization" may be permitted
- Regulatory review needs to preserve flexibility
  - Opportunity to use PB approach in application could be beneficial
  - PB review could speed up endorsement

ANS-58.8

"Time Response Design Criteria for Safety-Related Operator Actions"

- **Outcome:** Approved standard to justify operator actions to perform safety-related actions versus requirement for automatic action
- **Relevance:** Advanced reactors generally have plenty of **"margin"** so expensive safety-grade automatic action can be avoided
- **Performance-based feature:** Parameters and decision thresholds affecting operator actions with specified **"margins"**. Focus on functional success.
- **Possible Risk-informed feature:** Include requirement to estimate radiological consequence if margin is violated. PRA used for hypothesis testing.
- **Possible non-RIPB feature:** Avoid human factors analysis by specifying **"margin"** for deterministic safety case.

RP3C Report to Standards Board

Themes addressed in the meeting were:

- We learned lessons on RIPB by working on specific standards and by addressing the needs of the planning process
- We found that it was necessary to go back to the basics of RIPB and back to previously developed guidance
- Industry and NRC are converging on the need and urgency of using RIPB for advanced reactors
- The changing environment will support endorsement of RIPB standards that are based on basic concepts
- ANS has the opportunity to make a proactive choice on modernization of standards in a systemic way
- Given the challenges in preparing guidance that the Standards Committee can and will use, participants need to make the commitment to engage with RP3C.

Action Item Status

See Attachment 7

- Action Item 6/2013-01: Kadambi to update and distribute next draft of the Risk-Informed and Performance-Based (RIPB) Plan with member comments incorporated. (RIPB Plan renamed RP3C Vision Plan.)
- Action Item 6/13-05: Kadambi to prepare a note on weaving RIPB ideas into Tier 3 issues as defined by NRC.
- Action Item 6/13-07: Kadambi to prepare a note on how consensus standards activities can help address long-standing issues regarding defense-in-depth (DID).
- Action Item 11/2013-01: George Flanagan for provide Mark Peres a copy of the current ANS 54.1 draft for an example.
- Action Item 11/2013-02: Amir Afzali to provide George Flanagan the name of Southern Nuclear Company's technical expert to help on ANS-54.1.
- Action Item 11/2013-03: Amir Afzali to provide suggestions on how the RP3C Vision Plan can emphasize safety.

Closing

- **Other Business**
- **Next Meetings**
  - ANS Winter Meeting, November 11-15, 2018, Orlando FL
  - ANS Annual Meeting, June 9-13, 2019, Minneapolis, MN
- **Adjourn and Thank You!**

BACKUP

&

BACKGROUND

SLIDES

Example Outcome Objectives for Advanced Reactor Design

- Design decisions for advanced reactors are based on optimizing performance to support safety, economic, and societal objectives.
  - If regulatory precedents need to be considered, the costs of doing so will be balanced against the compromises needed relative to the main objectives.
- The assessment of effectiveness relative to accomplishing the above objectives will be part of the designer's decision making framework.
  - Assessment methods are commensurate with the importance of the design decisions relative to the functional objectives.
- Implementation decisions will focus on maximizing the benefits related to the technology in question.
- The level of risk associated with unknown factors would be subject to the designer's articulation of "how safe is safe enough (HSISE)."

A Standardized PB Framework

- What is emerging is that RI is useful in certain areas but opportunities for PB are more abundant.
- Prescriptive and deterministic requirements are likely beneficial for some DB considerations.
- A designer could choose to assure safety margins using a RIPB approach.
- Confidence//Reliability of achieving safety outcomes is the main consideration.

Performance Measures and Attributes

- PB framework based on NUREG/BR-0303 would consider safety margin as a performance measure in a scenario-based system.
- The safety margin can be defined in a graded manner dependent on whether DB, BDB, or residual risk is being considered.
- The gradation can be on the basis of level of confidence in the safety margin based on rigor of validation and/or conservatism of the analysis.
- The performance measure can also include the acceptable level of the probability of exceedance.
- A graded approach could consider as acceptable lower confidence levels in the safety margin as scenario frequency decreases.
- Similarly it may be acceptable to have increasing levels of probability of exceedance given a threshold being set.
- The PB framework would provide the designer flexibility to fulfill the attributes in the most economical manner.

Optimizing Performance Objectives Between Multiple Outcomes

- Consider outcomes related to safety, economics, and public acceptance.
- A designer is concerned about all three, but a framework does not exist to perform trade-offs transparently.
- The practices guide would provide top-down (IDMF) and bottom-up guidance among multiple hierarchies.
- An outcome objective for the guidance is that traceability and trackability would be available.
- Relationship between design practices and associated regulatory practice is based on functional analysis.

Designers' Outcome Considerations

- Safety
  - Functional adaptation of regulatory criteria based on principles and policies
  - Focus on enhancing benefits of technology
  - Focus on innovative methods and tools
- Economics
  - Consider practices more broadly beyond nuclear practice
  - Discrepancies reconciled through IDMF at levels above practices.
  - Discrepancies within nuclear technology would invoke NUREG/BR-0058, "Regulatory Analysis Guidelines."
- Public Acceptance
  - Involves local considerations and value judgements
  - Likely to primarily involve region of residual risk
  - May involve notions of defense-in-depth and HSISE

RIPB Management Framework

Suitable combination of processes to:

1. Model systems and assess risk
    a) Risk need not always involve exposure to radioactivity
    b) Risk can also be defined in terms of failure to meet objectives
    c) What type of risk analysis and how much quality in the analysis is sufficient to know this?
    d) Success can be defined as adequately low probability (with appropriate level of certainty) that an outcome will not be achieved
2. Specify and monitor performance objectives
    a) A suitable combination of objectives constitutes an outcome
    b) A successful outcome can be defined as a high enough probability (with appropriate level of certainty) that a specified set of objectives will be achieved
3. Conduct integrated decision-making
    a) Multi-attribute decision-making under uncertainty is a recognized part of decision theory disciplines
    b) A process with well defined success criteria involves a structured set of activities, each of which is characterized by a suitable set of qualitative and quantitative observable parameters.
    c) How likely is it that parameters observed are acceptable but outcome is unacceptable? (See NUREG/CR-6833)

Basis for RIPB Guidance

See Attachment 3

- Widely varying views are evident regarding purpose and expectations from RIPB methods
- For ANS standards, the regulatory authority and the Society's consensus views offer a basis
- Much probing deliberation has been documented at the NRC Commission level from the late 1990s
- ANS has developed consensus through efforts of Public Policy Committee and Board approval
- RP3C has a sound basis for recommending that Standards Board adopt the basis.

Current State of Guidance

See Attachment 3

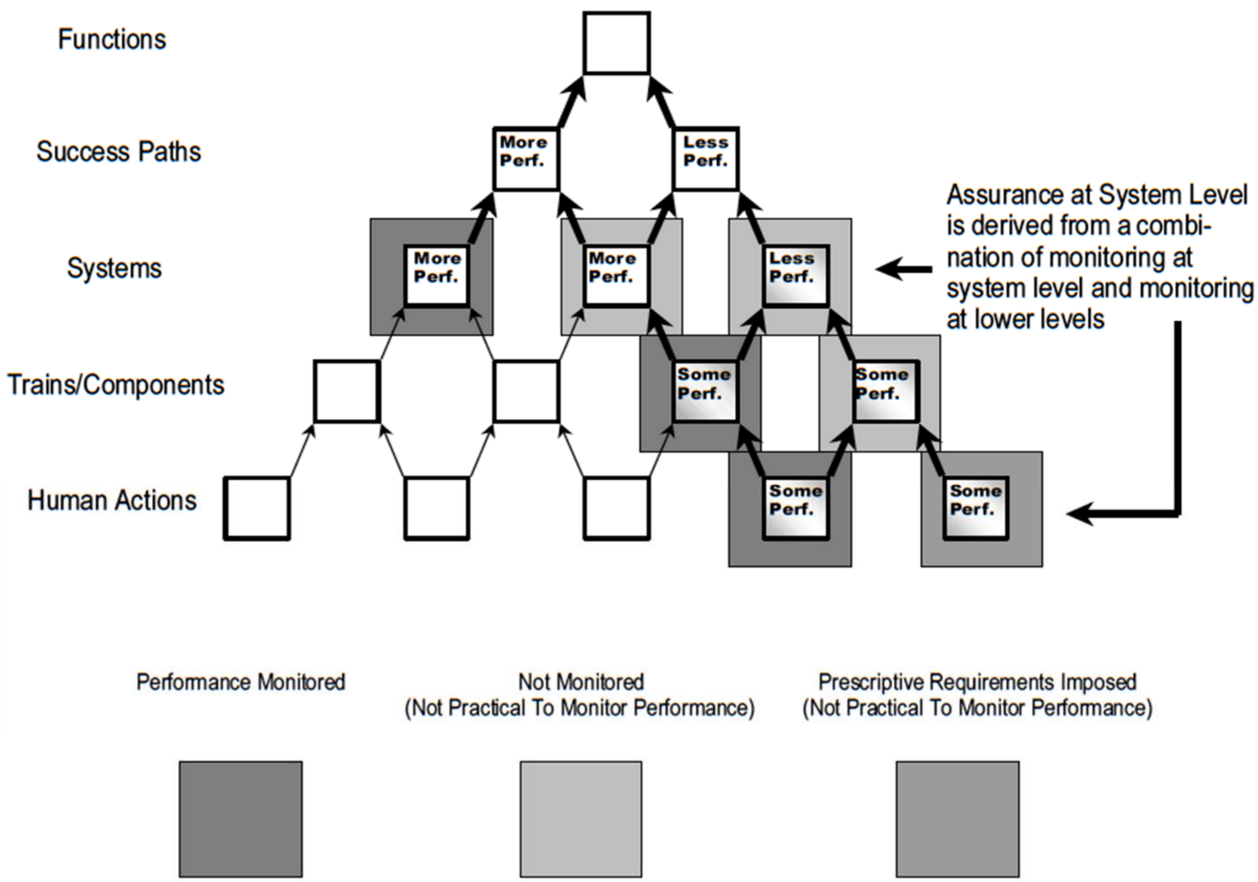
- Highlight necessity of common understanding regarding outcomes that characterize RIPB application
  - Expectations described in Commission level decisions
  - Beneficial to have authoritative, immutable basis
  - NRC staff not necessarily currently attuned
- Lack of convergence in technical community understanding of NRC positions on particular regulatory issues can add to licensing uncertainty
- RP3C can contribute by clarifying and communicating what we do or do not understand about NRC staff positions
- Experience with guidance development has shown importance of broad based discussions of nature and benefits of RIPB
- Discussion of “Changing Environment” will help clarify.

What is Performance-Based?

- The term "***performance-based"*** is to be understood in the context of **performance** being the result of an activity
- ***"Activity"*** is used in the widest possible sense
  - Example: Tweaking of a knob on a control panel
  - Example: Repurposing the activities of the General Electric Co. which has lost a substantial portion of its equity value due to flawed management
- Characterized by granularity, logical aggregation, and scalability
  - Example: Knob tweaking is highly granular
  - Example: Repurposing GE is highly aggregated
  - Scalability leads to logical aggregation of granular activities

Assuring Performance at Different Levels of the Hierarchy (2)

At a given node on this diagram, unless we are directly measuring its performance, we need enough assurance (PB, prescriptive, or process- based) at lower levels to be confident about performance of the given node



AMERICAN NUCLEAR SOCIETY STANDARDS COMMITTEE STRATEGIC PLAN January 2016 through December 2020
Revision 2 – December 22, 2017

(Contact standards@ans.org for accompanying SMART matrix if interested.)

Vision

The American Nuclear Society (ANS) Standards Committee is recognized as the leader in developing standards for the implementation of nuclear science and technology.

Mission

To develop and maintain high-quality, consensus standards that meet the current and anticipated future needs of the U.S. nuclear industry[1] and to promote their broad acceptance, endorsement, and use.

Goals and Objectives

Each of the following five goals is defined by its objective and supported by specific initiatives to achieve the goal.

Goal #1: Align Standards Development Priorities with Current and Emerging Industry Needs

Objective: Establish an approach and supporting systems to periodically collect industry priority input and integrate it into the standards priorities and delivery targets.

Initiatives

A. Evaluate the results from the initial industry standards priority survey.
B. Assign responsibilities to the appropriate consensus committees (CCs) to address the top ten survey-identified high-priority standards.
C. Develop and implement an approach to collect industry priority needs on an ongoing basis and integrate them into Standards Committee priorities.
D. Incorporate risk-informed and performance-based methods into ANS standards, where appropriate, as follows:
    1. Develop the Risk-Informed, Performance-Based Principles and Policy Committee (RP3C) Operating Plan.
    2. Develop a Risk-Informed, Performance-Based Principles training package for training of ANS Standards Committee members.
    3. Conduct training of CCs and working groups (WGs).
    4. Have the RP3C work with each CC to develop a prioritized list and schedule for incorporating risk-informed and performance-based principles into its standards. Collaboratively, RP3C will identify and define any new standards that are related to risk-informed and performance-based principles. Some such work may already have been assigned to other standards WGs, and so it is important to work with the Standards Board (SB) and CCs to identify an appropriate WG lead (and CC) for the standards development with the objective of avoiding duplication.

[1] The term “industry” as used in this plan means the portions of the nuclear science and technology community within the scope of the ANS Standards Committee.

5. Publish a *Nuclear News* article to inform other ANS members of the benefits of this risk-informed and performance-based effort.
6. Develop 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.

Goal #2: Develop and Maintain High-Quality Standards

Objective: Ensure that effective training and knowledge transfer are embedded in the standards development process and augment participant capabilities to develop and maintain high-quality standards.

Initiatives

A. Enhance relationships with the ANS Professional Divisions and Technical Groups to assist in populating WGs with expert individuals (also supports Goal #5).
B. Develop and implement a standards training program for all Standards Committee members to ensure that standards development is consistent with current policies and procedures, thus producing consistently higher-quality products in a timelier manner.
C. Assign a mentor to each new standards WG who is experienced in the use of ANS standards' procedures, policies, glossary, and toolkit.

Goal #3: Improve Standards Development Production and Efficiency

Objective: Improve efficiencies with respect to development and maintenance of ANS standards.

Initiatives

A. Expedite development of high-priority standards proactively focusing on timely development of new standards to meet identified industry needs by improving SB and CC oversight using achievable project plans and definitive schedules with assigned milestones throughout the standards development cycle.
B. Complete the Standards Volunteer Database to facilitate recruiting personnel for Standards Committee activities (also supports Goal #5).
C. Assist the CCs in obtaining required human resources using outreach initiatives.
D. Maximize use of the ANS Standards Workspace and other communications vehicles to eliminate the need for travel and face-to-face meetings to the extent possible.
E. Acquire funding (e.g., grants) to support the development of high-priority standards on an expedited basis.
F. Streamline the reaffirmation process to reduce the number of delinquent standards by establishing a systematic review of delinquent standards to start no later than the four-year mark. This can be accomplished through the following mechanisms:
    1. Automatically sending out a Reaffirmation Form to the WG chair with copies to subcommittee chair and CC chair.
    2. Automating subcommittee and CC approvals of reaffirmation, withdrawal, and revision recommendations.
    3. Establishing an ANS Professional Division and Technical Group sponsorship program to aid in review of associated delinquent standards with and without active WGs.
G. Develop subcommittee/CC metrics to identify opportunities for improvements.

Goal #4: Expand ANS Awareness and External Outreach

Objective: Improve interfaces between the Standards Committee and other segments of ANS and with other industry organizations through better communication related to existing standards and standards development activities to ensure continuing relevance.

Initiatives

A. Use periodic survey methods to gain feedback from the industry and federal and state agencies; provide feedback to survey responders.
B. Establish periodic leadership meetings with regulatory agencies, owners' groups, and industry executives to align needs and build support for development and greater use.
C. Establish an ANS Professional Division sponsorship program to broaden input in setting standards priority.
D. Seek liaison arrangements with relevant standards development organizations, where needed, to improve efficiency, effectiveness, and consistency of standards across the industry where overlapping or interlocutory standards arise.
E. Establish an approach to keep industry and trade groups advised of approved standards and in-progress standards in their areas of interest.
F. Identify key international organizations that can contribute to specific ANS standards development projects, including WG participation, review of draft standards, and providing input into standards prioritization.
G. Establish a standards educational program for non–Standards Committee members to increase their knowledge of
    1. what consensus standards are and are not;
    2. the benefit of consensus standards to the industry; and
    3. the advantages to companies, federal and state agencies, and individuals of supporting standards development.
H. Contact leading nuclear companies to determine if they issue regular newsletters and offer to provide standards updates for inclusion.
I. Evaluate the cost effectiveness of a fee-based training program for newly issued/revised standards.

Goal #5: Increase Participation in ANS Standards Working Groups, Subcommittees, and Consensus Committees

Objective: Increase participation in ANS standards development to (1) ensure continued technical capability of Standards Committee members, (2) enhance knowledge capture and transfer, and (3) increase participation of young nuclear professionals.

Initiatives

A. Approach owners' groups and industry organizations soliciting member participation in ANS standards.
B. Send notices to ANS Student Section members, Young Members Group, Professional Division members, and North American Young Generation in Nuclear members to provide opportunities to participate in ANS standards.
C. Enhance relationships with the ANS Professional Divisions and Technical Groups to assist in populating WGs with expert individuals (also supports Goal #2).
D. Advertise upcoming standards efforts with requests for support using *Nuclear News*, the ANS Nuclear Cafe blog, and the ANS LinkedIn group.
E. Complete the Standards Volunteer Database and make it available to subcommittee and CC chairs (also supports Goal #3).
F. Monitor CC and WG success in staffing and recruitment and share best practices across all CCs.

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

ATTACHMENT 2B

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 done 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					
A. Evaluate the results of the initial industry priority survey	Standards Mgr	Executive summary issued.		1/2016	1/2016
B. Assign responsibilities to the appropriate consensus committees to address the top ten survey identified high priority standards	Standards Mgr	Issue list of high priority standards with assigned responsibilities. List discussed during 2/12/2016 conference call and published in minutes.		2/29/2016	2/29/2016
C. Develop and implement an approach to collect industry priority needs on an ongoing basis and integrate them into standards committee priorities.	Chair External Communications TG	ANS SC Policy drafted to specify this approach and approved by SB.	1/25/17: With no External TG Chair, there has been no action	2/1/2017	
D. Incorporate risk-informed and performance-based methods in ANS standards, where appropriate, by: 1. Develop the Risk-Informed Performance-Based Principles and Policy Committee Operating Plan 2. Develop a Risk-Informed Performance-Based Principles training package for training of ANS Standards Committee members. 3. Conduct training of consensus committees and working groups. 4. The RP3C will work with each consensus committee to develop a prioritized list and schedule for incorporating risk-informed and performance-based principles into its standards. Collaboratively, they will Identify and define any new standards that are related to risk-informed and performance-based principles. Some of such work may already have been assigned to other standards working groups, and so it is	RP3C Chair	Provide draft of Risk-Informed Performance-Based Principles and Policy Committee Operating Plan for SB approval.	Draft plan provided for info 11/2017.	9/30/2017	
	RP3C Chair	Provide resolution of SB comments and issue plan CC ballot.		12/1/2017	
	RP3C Chair	Develop priority list of standards and schedule for incorporation of RP3C principles.	Initial draft list of potential potential risk informed and performance based standards provided 11/2017..	9/30/2017	
	RP3C Chair	*Nuclear News* (*NN*) article drafted, approved by SB Chair, and forwarded to *NN* editor.		11/1/2017	

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
important to work with the SB and CCs to identify an appropriate WG lead (and CC) for the standards development with the objective of avoiding duplication. 5. Publishing a Nuclear News Article to inform other members of the Society of the benefits of this risk-informed and performance-based effort 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 Risk-Informed and Performance-Based Training Package for SC members and provide to SB for review.	To be developed in parallel with plan finalization	12/1/2017	
	RP3C Chair	Develop presentation package for use with other industry groups and submit to SB for approval.	To be developed in parallel with plan finalization	3/1/2018	
	RP3C Chair	Contact appropriate organizations to make presentations at NRC RIC, ANS UWC, and owners' groups.		7/1/2018	
	RP3C Chair	Make presentations at a minimum of 2 groups.		10/1/2018	
Goal #2: Develop and Maintain High Quality Standards					
A. Enhance the relationships with the ANS Professional Divisions and Technical Groups to assist in populating WGs with expert individuals. (also supports Goal 5)	Internal Communications TG Manager	Issue interface liaisons table between applicable divisions and group and the standards consensus committees.		8/1/2016	6/1/2016
	CC Chairs	Send requests for staffing assistance to ANS Professional Divisions and Technical Groups as needed.	11/2017: ESCC – Done FWDCC - Done LLWRCC - Done NCSCC - Done NRNFCC - Done RARCC - None identified SRACC - Done	Initial requests sent prior to Oct. 2017 meeting. Ongoing	11/1/2017
	Internal Communications TG Manager	Tabulate the summary of the requests made and the results and present to SB.	This item has been replaced by having the CC Chair report the results in their SB reports	NA	

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
B. Develop and Implement a standards training program for all Standards Committee members to ensure that standards development is consistent with current policies and procedures, thus, producing consistently better quality products in a timelier manner.	Internal Communications TG Manager	Develop initial presentations and post on Workspace.		3/1/2016	3/1/2016
	SB VChair	Assign training instructors.		3/1/2016	3/1/2016
	SB VChair	Prepare training plan.		2/1/2016	2/1/2016
	Standards Mgr	Send out training notices.		3/15/2016	3/15/2016
	Standards Mgr	Complete the initial rounds of training presentations.		6/2/2016	6/2/2016
	SB VChair	Select videos for use in future training presentations.		6/2/2016	6/2/2016
C. Assign a mentor to each new standards working group that is experienced in the use of ANS standard's procedures, policies, glossary and tool kit	CC Chair	Evaluate SubC Chairs for familiarity with toolkit/standards development.	11/2017: ESCC – Done FWDCC - Done LLWRCC - Done NCSCC - Done NRNFCC - Done RARCC- Done SRACC - Done	5/1/17	5/31/2018
	CC Chair	Select SubC Chairs and other CC members with respect to their being well versed in toolkit contents and capable of being mentors. Provide mentor list to SB VChair.	11/2017: ESCC – Done FWDCC - Done LLWRCC - Done NCSCC - Done NRNFCC - Done RARCC - Done SRACC - Done	5/1/17	
	CC Chair	In cases where additional assistance is required beyond the SubC Chair, CC should request mentor	None identified yet	Chairs have been advised.	11/1/2017

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
		from SB VChair.			
Goal #3: Improve Standards Development Production and Efficiency					
A. Expedite development of high-priority standards by improving Standards Board and consensus committee oversight using achievable project plans and definitive schedules with assigned milestones throughout the standards development cycle.	SB VChair	Draft project plan development policy.		10/1/2016	Approved by SB 9/6/16. Project plan w/b added to CC procedures as Appendix K.
	SB VChair	Project plan development policy approved by SB.		12/1/2016	
	CC Chairs	Develop project plans for 6 total standards from all CCs and submit to consensus committees. This is the total goal for all CCs not 6 by each CC.	1/25/17: 5 plans have been developed to date.(2.27, 54.1, 2.25, 2.29, and the JCNRM milestone schedule) NRNCC to develop 2 plans for standards in progress.	6/1/2017	
B. Complete the Standards Volunteer Database to facilitate recruiting personnel for Standards Committee activities (also supports Goal #5)	ANS IT Dept.	ANS IT complete ANS SC Volunteer Database in accordance with the SB specification.	Pat sent a follow up message just last Monday (5/14/18) to J. Koblich (IT). Sslide about the database added to the draft BOD presentation I prepared for Steven Arndt.	11/1/2017	
	ANS IT Dept.	SB approves database submitted by ANS IT department.		2/1/2018	

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
C. Assist the consensus committees in obtaining required human resources using outreach initiatives	Standards Mgr	Develop staffing approach guideline and post to website toolkit.		12/1/2016	Completed by S. Stamm and posted to the toolkit on 8/22/16 here.
D. Maximize use of the ANS Standards Workspace and other communications vehicles to eliminate the need for travel and face-to-face meetings to the maximum extent possible	CC Chairs	Encourage WGs and SubCs to use Workspace and other online and electronic tools to eliminate face-to-face meetings	Procedure issued. CCs have discussed with SubC /Chairs	Done	April 2017
	CC Chairs	CC chairs to submit a confirmation email that this has been discussed with SubCs and WGs.	11/2017: ESCC – Done FWDCC - ?? LL\WRCC?? NCSCC - Done NRNCC - ?? RARCC - Done SRACC - Done	5/1/2017	
E. Acquire funding (e.g., grants) to support the development of high-priority standards on an expedited basis.	CC Chairs/ Priority TG Chair	High priority standards list submitted by all CCs which identify high priority standards planned for near future. Priorities should be based on expected government and industry need.	11/2017: ESCC – ANS-2.8(12/31/17) FWDCC - ?? LWRCC - ?? NCSCC - None NRNFCC None RARCC - ANS 20.1, 20.2, 30.1 and 30.2 SRACC - None	Ongoing	
	SB VChair	Work with CCs to assess each effort, select most appropriate standards, prepare and submit proposals. Submit 1st proposal.	Nov 2017- Agreed to proactively coordinate with NRC and DOE for early identification of potential opportunities.	6/1/2017 Ongoing	

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
F. Streamline the reaffirmation process to reduce the number of delinquent standards by establishing a systematic review of delinquent standards to start no later than the 4-year mark. This can be accomplished through the following mechanisms: 1. Automatically sending out a Reaffirmation Form to the WG chair with copies to subcommittee chair and consensus committee chair 2. Automate subcommittee and consensus committee approvals of reaffirmation, withdrawal, and revision recommendations 3. Establishing an ANS Professional Division and Technical Group sponsorship program to aid in review of associated delinquent standards with and without active working groups	Standards Mgr	Submit Reaffirmation Forms to WG/SubC Chairs for all standards approaching the 4-year mark.		Ongoing Starting 4/1/2016	Ongpoing
	Standards Mgr	Issue list of all standards over 4 year since issuance showing the issuance of Reaffirmation Forms to the WG chairs.		11/1/2016	Ongoing
	Standards Mgr	Action items for reaffirmation setup in Workspace with automatic reminders.		11/1/2016	The report was sent 9/15/16 and will be updated and resent 12/15/16
	Internal Communications Group Manager	Send list of delinquent standards to PDs.		12/1/2016	Completed
	Internal Communications Group Manager	Issue plan and approach to each Professional Division and Technical Group as applicable and obtain indication of acceptance.	COMPLETE	5/1/2017	11/2017
G. Develop subcommittee/consensus committee metrics to identify opportunities for improvements	Policy TG Chair	Identify CC metrics, review with CC Chairs.		10/1/2016	Changed to done!
	CC Chairs	Each CC fill in annual tabulated metric performance.	COMPLETE	5/1/2017	4/1/2017
	Policy TG Chair	Evaluate metric results.		3/1/2018	
	CC Chair & Policy	Provide recommendations for changes to improve	11/2017:	6/1/2018	

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
	TG Chair	performance.	ESCC- None		
Goal #4: Expand ANS Awareness and External Outreach					
A. Use periodic survey methods to gain feedback from industry, federal and state agencies; provide feedback to survey responders	SB VChair	Submit draft of survey comment responses to SB Chair for approval.		8/1/2016	7/26/16
	SB Chair	Send responses to commenters.		10/1/2016	Done
	SB Chair	Determine survey frequency for future ANS and industry surveys.	1/25/17: Members recognized that the EC TG Chair position was open and no action has been taken.	10/1/2016	
B. Establish periodic leadership meetings with regulatory agencies, owner's groups and industry executives to align needs, and build support for development and greater use	Chair External Communications TG	Discuss communications approach with each of the applicable organizations (industry, federal. and state agencies). Setup regular schedule for discussions.		11/1/2018	
	Chair External Communications TG	Develop and issue master SC external communications plan.		5/1/2017	
C. Establish an ANS Professional Division sponsorship program to broaden input in setting standards priority	Chair Internal Communications TG	Issue plan and approach to each Professional Division and Technical Group as applicable and obtain indication of acceptance.	"Plan" was provided to liaisons. Confirmation pending	10/1/2016	6/2017
D. Seek liaison arrangements with relevant SDOs, where needed, to improve efficiency, effectiveness and consistency of standards across the industry where overlapping or interlocutory standards arise	Chair External Communications TG	Prepare a liaison list identifying each desired liaison interface, the liaison approach, and the implementation status.	1/25/17: Members recognized that the EC TG Chair position was open and no action has been taken.	10/1/2016	3/1/2017

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
	Chair External Communications TG	Implement all liaisons on the Liaison Interface List.	1/25/17: Members recognized that the EC TG Chair position was open and no action has been taken	10/1/2016	11/2017
E. Establish an approach to keep industry and trade groups advised of approved standards and in-progress standards in their areas of interest	Chair External Communications TG	Issue an Industry and Trade Group Interface Plan.	1/25/17: Members recognized that the EC TG Chair position was open and no action has been taken.	10/1/2016	
	Chair External Communications TG	Complete interface plan implementation.		6/1/2018	
F. Identify key international organizations that can contribute to specific ANS standards development projects, including work group participation, review of draft standards, and providing input into standards prioritization.	Chair External Communications TG	Develop listing of key international organization, key contacts, and the desired interfaces we would like to develop.		6/1/2017	
	Chair External Communications TG	Send invitation letter to each of the interface contacts. Follow-up as needed		10/1/2017	
	Chair External Communications TG	Provide completion report to SB.		10/1/2018	
G. Establish a standards educational program for non-Standards Committee members to increase their knowledge of: 1. what consensus standards are, and are not; 2. benefit of consensus standards to the industry; 3. advantages to companies, federal and state agencies, and individuals of supporting standards development	Chair External Communications TG	Develop presentation package.		6/1/2016	6/1/2016
	Chair External Communications TG	Develop invitation list for indoctrination sessions.		8/1/2016	All ANS members
	Chair External Communications	Send indoctrination session invitations.		10/1/2016	sent via Jan 2017 N&D,

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
	TG				member blast, and ANS home page.
	Chair External Communications TG	Conduct 1st indoctrination session.		2/1/2017	1/31/2017
	Chair External Communications TG	Complete sessions.		11/1/2017	
H. Contact leading nuclear companies to determine if they issue regular newsletters and offer to provide standards updates for inclusion.	Chair External Communications TG	Develop list of companies and contacts.	1/25/17: Members recognized that the EC TG Chair position was open and no action has been taken.	11/1/2016	
	Chair External Communications TG	Develop short form newsletter.	1/25/17: Members recognized that the EC TG Chair position was open and no action has been taken.	11/1/2016	
	Chair External Communications TG	Make contact with 30% and report to SB.	1/25/17: Members recognized that the EC TG Chair position was open and no action has been taken.	4/1/2017	
	Chair External Communications TG	Make contact with 100% and report to SB.		11/1/2017	
I. Evaluate the cost effectiveness of a fee based training program for newly issued/ revised standards.	SB VChair	Prepare draft evaluation plan.		8/1/2016	7/26/2106
	SB VChair	Meet with ANS Membership & Marketing Director and		8/3/2016	Several calls

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
		revise plan as appropriate.			held; last one on 10/5/16.
	SB VChair	Complete evaluation and send report to SB Chair for discussion with BOD.		3/1/2017	Completed Jan 2017 – Recommended ANS-2.8 & ANS-3.5 once approved.
Goal #5: Improve Industry Representation and Sustainability of Working Groups, Subcommittees, and Consensus Committees					
A. Approach owners' groups and industry organizations soliciting member participation in ANS standards	Standards Mgr	Send owners' groups semi-annual updates on applicable standards activities	Industry newsletter created and provided to Jim Riley as POC for utilities on 10/18/16. Industry newsletter posted here.	Ongoing	
	Standards Mgr	Request staffing assistance for select standards.	An updated list of volunteer needs was prepared and posted to the ANS website 8-11/16, announced in Sept. 2016 N&D and distributed through ANS Collaborate to PDs.	Ongoing	
A. Send notices to ANS Student Section members, Young Member Group, Professional Division members, and North American-Young Generation Nuclear members to provide opportunities to participate in ANS standards					
	Standards Mgr	Send notices biannually.	Broadcast sent to ANS Student Section 9/15/16.	Ongoing Biannually	
B. Enhance the relationships with the ANS Professional Divisions and Technical Groups to assist in populating WGs with expert individuals.(See Goal #1)		.(See Goal #1)			
C. Advertise upcoming standards efforts with requests for support using *Nuclear News*, Nuclear Café, and ANS Linked-In Group	Standards Mgr	Advertise upcoming standards efforts with requests for support using *Nuclear News*, Nuclear Café, and ANS	Volunteer needs section added to *Nuclear News*. List	Ongoing	

SMART Matrix for ANS SC Strategic Plan – Updated 5/31/2018

Initiative	Assigned Responsibility (Functional Title)	Specific Action Items Needed to Accomplish the Initiative	Status/ Comments	Scheduled Completion Date	Actual Completion Date
		Linked-In Group.	of volunteer needs updated and posted to web and announced in N&D.		
D. ANS IT Department to complete the Standards Volunteer Database, and make it available to subcommittee and consensus committee chairs (See Goal #3)		(See Goal #3)			
E. Monitor consensus committee and working group success in staffing and recruitment and share best practices across all consensus committees	SB VChair	Develop standard report and provide to CC Chairs.	1/25/17: Stamm confirmed that this action will be completed shortly.	6/11/17	6/11/17
	CC Chairs	Changed to annual report based on performance data provided to the CC Chairs.		6/30/2018+ Ongoing	
	SB VChair	Evaluate results of CC reports at SB meeting		6/30/2018+ Ongoing	

What is RP3C's SMART Matrix?

SMART Matrix

What It Is

- A SMART matrix is a communication and planning tool used to identify the specifics of actions or tasks.
- SMART stands for *specific, measurable, attainable, resources,* and *time.*
- It is an L-shaped matrix designed to capture the key points of a team's project objectives.
- It provides a process to review how actions are being implemented around various attributes.

When to Use It

- When you need to analyze an implementation plan's tasks to ensure they are on track.
- When you need to understand the amount of resources needed to implement a plan.
- When you need to understand how the various tasks are sequenced and related.

How to Use It

- On a piece of flip chart paper draw an L-shaped matrix with five columns labeled Specific, Measurable, Attainable, Resources, and Time.
- Write the implementation plan title in the upper left of the chart.
- Detail the specific tasks to be performed. Make the task statement detailed and well defined. The example in the figure below shows a combination of task and objective statements providing measures, outcomes, and time frames.
- For each detailed specific task:
  - Define a measure or indicator that can be tracked.
  - Determine how it will be attained in actionable terms that are realistic and feasible.
  - Indicate the amount and type of resources required to complete each task identified.
  - Identify the timeline for completion.
- Once you have completed the matrix, review the results with the implementation team to ensure that you have accounted for and recorded everything.
- Review the matrix to make sure the timeline is realistic and all tasks are not due to be completed on the same day.
- Review the matrix and get a feel for the total amount of resources required. Determine if they are available or if adjustments need to be made.

RP3C Activity	Specific	Measurable	Attainable	Resources	Time
Activity 1					
Activity 2					
Activity 3					
Activity 4					
Activity 5					
Activity 6					
Activity 7					
Activity 8					

<u>Risk-Informed Performance-Based Principles and Policy Committee Operating Plan</u>
DRAFT 5-2018

1. Introduction

In 2013, the American Nuclear Society's (ANS) Standards Board (SB) established a Risk-Informed and Performance-Based Principles and Policy Committee (RP3C) responsible for developing approaches, priorities, responsibilities and schedules for implementation of risk informed and performance based (RIPB) principles in ANS standards.

This operating plan describes the RP3C goals and activities/processes that RP3C will perform/utilize to meet its responsibilities consistent with the RP3C bylaws.

2. RPC3 Activities/Processes

2.1 Development of RIPB Guide for ANS Committees and Working Groups

The RP3C will develop a guidance document on concepts/methods that can be used to make ANS standards more risk-informed and/or performance-based during revision or initial development. This guide will discuss the integration of existing requirements with risk informed and performance based requirements.

The guidance document will be based on first developing an understanding of the nature and scope of ANS standards and projects (current, withdrawn, active, inactive). Available data on the ANS standards and projects will be categorized into one of three categories – RIPB, PB, and not applicable. The categorized list will be shared with the Consensus Committees in the ANS Standards Committee and assignments will be made for CCs to review and discuss with RP3C.

In parallel with the categorization, implementation of RIPB principles will be pursued with Working Groups for several ongoing standards activities. The content of the RP3C guidance document will be informed by the experience with implementation of RIPB principles relative to these standards activities.

2.1.1 Categorization of ANS Standards and Projects

The categorization activity will be performed by the team of Ed Wallace, Alan Levin, and Jim August. The data available in the following link will be used:

https://workspace.ans.org/higherlogic/ws/groups/scg/documents

<u>Schedule (TBD):</u>
- 1st draft sent to RP3C committee
- Comments included and 2nd draft sent to RP3C
- 3rd draft sent to CCs and Standards Board

<u>Responsibilities:</u>
- Lead Ed Wallace

2.1.2 Develop RIPB guidance document for CCs

The guidance document on concepts/methods that can be used to make ANS standards more risk-inform and/or performance-based during revision or initial development will be prepared using generally accepted principles and policies as documented for practices being currently proposed or implemented successfully as recommendations for ANS Standards. This guide will discuss the integration of existing requirements with risk informed and performance based requirements.

Schedule (TBD):
- 1st draft sent to RP3C committee
- Comments included and 2nd draft sent to RP3C
- 3rd draft sent to CCs and Standards Board

Responsibilities:
- Lead Prasad Kadambi

2.1.3 Pilot Implementation of RIPB Principles in specific standards activities

The pilot implementation of RIPB principles in these standards activities will be pursued in cooperation with the WG Chairs by Prasad Kadambi, Jim O'Brien and Ed Wallace.

Schedule (TBD):
- Develop Action Plan for pilot implementation for each standard
- 1st draft of implementation experience report to RP3C
- Update Guidance Document for CCs as applicable

Responsibilities:
- Lead Prasad Kadambi

2.2 Indoctrination of Standards WGs in RIPB

The RP3C will set up webinar to brief the WGs on RIPB guide, outline advantages of inclusion RIPB in standards, and how the RP3C will operate to support WGs in developing more RIPB standards.

Schedule (TBD):
- Draft of training package provided to Standard Board
- Trail run of training provided to RP3C and Standard Board
- Amended presentation based on RP3C and SB feedback
- Begin Webinar presentations to CCs and WGs

Responsibilities:
- Lead Ed Wallace

2.3 RP3C support and review of ANS standards

The RP3C will develop a process for RP3C support and review of ANS standards including review of PINS, early interface with WG to identify areas and approaches that can be used in the standard, support of WG during draft standard development, review of draft standard prior to being sent for CC balloting.

Schedule (TBD):
- Draft of process document provided to Standard Board
- Comments included and 2nd draft sent to RP3C
- 3rd draft sent to Standards Board for balloting

The RP3C will work with each consensus committee to develop a prioritized list and schedule for incorporating risk-informed and performance-based principles into its standards

Schedule (TBD):

- Develop activities and schedules in consultation with CCs

Responsibilities:

- Lead Jim O'Brien

Identify and define any new standards that are related to risk-informed and performance-based principles that are not assigned to other standards working groups and work with the SB and CCs to identify an appropriate WG lead (and CC) for the standards development.

2.4 Interface with standards organization, industry groups and regulators

Interface with industry groups and organizations, as requested by the SB, for discussions related to achieving better coordinated risk-informed and performance-based principles and topical activities.

Specifically will interact with the JCNRM, NEI, INPO, NRC, and DOE to get their perspectives on how ANS standards could be developed or revised that make them more RIPB and better support industry and regulator objectives to support safe and efficient nuclear facility designs and operations as related to standards.

It is expected that the work of RP3C will consider and promote a wide range of outcome-oriented probabilistic applications in helping ANS standards activities become more risk-informed and performance-based. A key area where a huge amount of literature exists waiting for application is decision theory and methods for decision-making under uncertainty. The RP3C will focus on developing a paper on how probabilistic/decisionmaking applications may be utilized to support for desired safety outcomes in the use of ANS standards Clearly defining safety outcomes, together with performance assessment and monitoring, are essential elements of a performance-based approach.

Schedule (TBD):

- Perform initial set of discussions

Responsibilities:
(Multiple, e.g.)

- Amir Afzali, Advanced Reactor Regulatory Task Force
- Ed Wallace, various
- Bill Reckley, NRC
- Jim O'Brien, DOE

2.5 Self-Assessment for Effectiveness

Effectiveness is defined as the degree of congruence between expectations regarding targeted improvements and the observed outcomes.

Schedule:

-

Responsibilities:

-

Additional activities to be included on an ad hoc basis:

1. Interface with JCNRM – SCORA to coordinate risk application development and avoid duplication of efforts
2. Identify potential funding opportunities to advance ANS standards development and use. With the approval of the SB Chair pursue those not assigned to a Consensus Committee or other SB committee.

Procedural Guidance for Incorporating Risk-Informed and Performance-Based Approaches in ANS Standards (Attachment 3)

Consensus of Standards Board Required Prior to Implementation

1. PURPOSE

The purpose of this procedure is to outline a process that can be used by developers of standards to incorporate risk informed and performance based approaches.

2. BACKGROUND

Risk Informed Performance Based (RIPB) principles enable economical implementation of a graded approach to safety so that resources and higher quality expectations are associated with the most important activities contributing to the desired outcome. At the same time, safety implementation would avoid resource expenditures that do not provide benefits through reduced risk.

NRC has defined the 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." [see SRM-SECY-98-0144].

Additionally, the NRC has also provided a definition for a "Performance-based Approach" as follows: ""Performance-Based Approach": A regulation can be either prescriptive or performance-based. A prescriptive requirement specifies particular features, actions, or programmatic elements to be included in the design or process, as the means for achieving a desired objective. A performance-based requirement relies upon measurable (or calculable) outcomes (i.e., performance results) to be met, but provides more flexibility to the licensee as to the means of meeting those outcomes. A performance-based regulatory approach is one that establishes performance and results as the primary basis for regulatory 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."

NFPA 805 is an example of a standard that was endorsed by the NRC and labelled as performance-based. It was prepared by the NFPA Technical Committee on Fire Protection for Nuclear Facilities. Issued by the Standards Council on January 13, 2001, it was approved as an American National Standard on February 9, 2001. NFPA 805 describes a methodology for establishing fundamental fire protection program.

The NRC evaluated NFPA 805 and determined that, in general, it is consistent with the principles for performance-based regulation. It provides for the establishment of a minimum set of fire protection requirements but allows performance based or deterministic approaches to be used to meet performance criteria. Under NFPA 805, a licensee adopts the performance goals, objectives, and criteria itemized in Chapter 1 of NFPA 805 and then meets those goals, objectives, and criteria through the implementation of performance-based or deterministic approaches.

The NFPA 805 methodology incorporates the following attributes: (1) measurable or calculable parameters exist to monitor the system, including facility performance; (2) objective criteria to assess performance; and (3) flexibility to determine how to meet established performance criteria in ways that will encourage and reward improved outcomes.

NFPA-805 was examined for the purpose of finding elements that could be used directly in ANS standards. It was determined that NFPA-805 would not be a suitable example to base procedural guidance for ANS CCs.

3. PROCEDURE

3.1 Determining whether standard can utilize performance based principles

All standards prescribe to certain extents <u>what</u> (the outcome) is to be obtained from using the standard and to different level, <u>how</u> to obtain the outcome.

Depending upon the outcome to be achieved there may be only one way to achieve it. For example, in determining decay heat load, it is necessary to specify <u>a</u> heat generation rate. This would be a prescriptive requirement for design. For other outcomes, there may be more than one way to obtain the outcome. In these cases the standard should still identify the process for achieving the outcome but the process can include flexibility in <u>how</u> the outcome is achieved. The degree of flexibility equates to the amount of performance based.

This is discussed further below.

3.1.1 Define ultimate outcome of the Standard

Clear understanding (and statement) of the ultimate outcome of the standard is a critical step in any standard development. It will also be necessary in determining whether the standard is candidate for being performance based.

3.1.2 Define the approach (major steps) to obtaining the outcome

In order for a standard to be a "standard" it must define and require the use of the approach for achieving an outcome. The goal of a standard is to define the approach such that there is a high level of confidence that the outcome will be achieved.

3.1.3 Determine whether there are alternative approaches for achieving the outcome.

For some situations there will only be one approach that will result in achieving the outcome (e.g., calculation of decay heat load). In that case the standard is not suitable to be made "performance based."

In other situations, there may be different means to establish the outcome (for example achieving an appropriate fire protection program or radiation protection program). In this situation the standard development working group should determine the level of specificity in the definition of the process for achieving the outcome (or sub outcomes) is necessary.

3.2 Determine whether the standard can utilize risk informed approach to allow for more efficient achieving of outcomes

The following are ways to utilize risk informed approaches in standards development:

- Make the ultimate outcome is risk based (e.g., consequence at a given frequency): An example of this is seismic standards.

- Specify the use of probabilistic or statistical methods for achieving the outcome: An example of this is a standard that uses collection of an expert based data (or other data) such as the seismic hazards process
- Allow different approaches to be made to achieve outcomes but specify the approach used be justified to provide an appropriate level of confidence on the accuracy or repeatability of achieving the outcome. An example of this is where the margin of safety provided (or amount of conservatism) is based the confidence (or uncertainty) associated with the data or the process used in achieving the outcome.
- Allow risk insights to provide the basis for decision-making regarding parameters that dictate the scope of a program (radiation protection program) and/or areas the program will focus on.

If the standard can be developed (or updated) using any of these approaches; then it may be a good candidate for risk informing.

3.3 Determining whether to apply performance based, risk informed, or performance based/risk informed approach for the standard.

The reason to apply a performance based, risk based, or a performance based/risk informed approach in a standard is that it will result in an outcome that is more useful to the standard user(s). This means that if provides better assurance of safety and/or better utilization of resources to achieve the appropriate level of safety.

American Nuclear Society

ANS/NRC Workshop to Develop a Strategic Vision for Advanced Reactor Standards

May 2, 2018 | 8:30 a.m. to 4:30 p.m. EDT
U.S. Nuclear Regulatory Commission
Three White Flint North
11601 Landsdown Street
North Bethesda, MD

On May 2, 2018, the American Nuclear Society (ANS) and the U.S. Nuclear Regulatory Commission (NRC) sponsored a workshop for industry partners to develop a strategic vision and path forward for advanced reactors standards. The workshop provided an opportunity for designers, vendors, owners, regulators, and representatives of standards development organizations (SDOs) to discuss standards needs to support advanced reactors. There were 121 participants either in person or remotely. (see Attachment 1 for a full list of attendees and Attachment 2 for webinar participants). A summary of the workshop is provided below.

1. Introductions

ANS Standards Board Chair Steven A. Arndt welcomed and thanked all for participating. The purpose of the workshop was explained. ANS President Robert Coward was introduced. He emphasized the importance of this workshop. He explained that he has come to two conclusions this year during this travels: 1) There is no nuclear future without nuclear today, and 2) The nuclear future doesn't look like it does today. We need to firm up the foundation and create a new nuclear future. This workshop is building the bridge. Coward urged attendees to reach out and encourage young professionals to join this effort. Lastly, he stated that we need standards that lead and guide nuclear facilities that address user needs.

Arndt continued stressing that the workshop was a goal setting forum. He reviewed the logistics for the workshop and the breakout questions each technology was asked to address. See Attachment 3 for Arndt's presentation providing more detail.

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2. Presentations of Needs by Technology Working Groups

Technology Working Group (TWG) representatives for fast reactors, high temperature reactors, and molten salt reactors each presented information related to standards needs in there technical areas. Matthew Miller presented on behalf of the high temperature reactor group. Jason Redd presented for the molten salt reactor group. Paolo Ferroni stepped in at the last minute to represent the fast reactor group on behalf of TWG chair Jason DeWitte. Each presentation included a technology overview and indicated whether they have any unique features. Potential areas for future standards needs were identified. Presentations are available as follows:

- High Temperature Reactor Technology Working Group—Attachment 4
- Molten Salt Reactor Technology Working Group —Attachment 5
- Fast Reactor Technology Working Group—Attachment 6

TWGs recognized the benefit of standards, particularly endorsed standards. Standards were preferable, but if not available, designers would need to prepare their own guidance. The lack of a standard was not expected to delay development of advanced reactors. Several topical areas for standards were recommended for further discussion during the breakout sessions.

3. Breakout Sessions (by Technology)/Summary Preparations

Workshop participants divided into three groups by technology—fast reactors, high temperature reactors, and molten salt reactors—to discuss the assigned questions. Discussions were summarized to report back to the full group.

4. Presentations on Breakout Session Results

Workshop participants reassembled for a report of breakout sessions results. Representatives reporting on discussions were Peter Hastings for the high temperature breakout group, Jason Redd for the molten salt reactor group, and Paolo Ferroni for the fast reactor group. Responses to the five breakout questions for the three technology groups are provided below in table format for comparison. Presentations from the high temperature breakout groups (Attachment 7) and the fast reactor breakout group (Attachment 8) provide additional details.

1. For your technology, what would you say is the current status of standards to support the development, design, and licensing of advanced reactors? Are most of the needed standards available up to date? Do they cover the issues that have the most significant impact on the design? On the schedule?		
High Temperature Reactors	**Molten Salt Reactors**	**Fast Reactors**
• Generally speaking, sufficient for both licensing and design • ASME NQA-1, Quality Assurance, stability to be sought later • Evaluation of ANS-53.1, Modular Helium-Cooled Reactor (MHR) Design Process; ANS-30.1, Risk-Informed/Performance-Based (RIPB) Principles and Methods; ANS-30.2, Categorization and Classification of Structures, Systems, and Components (SSCs); in parallel with and informed by the Licensing Modernization Project (LMP) worthwhile and timely • LMP resolution • Consistency between ANS-53.1, MHR Design Process, and others	• Agrees that what is currently available is sufficient to move forward • Instrumentation and control (I&C) is the most important area • Environment safety also important • Would like to have a performance based-standard for acceptance criteria	• Existence of standards is not a requirement but is important to accelerate licensing • Existing standards represent a good starting point; however, they are not always up-to-date and/or best-suited for non-light water reactor (LWR) technologies • Some high-priority standards (schedule-wise) would benefit from modifications, (e.g. ASME NQA-1, Quality Assurance) • Would like existing standards (~860) grouped in high-level categories to facilitate their identification and priority-based use; work done at Oak Ridge National Laboratory for sodium fast reactor standards can be leveraged

2. List the five most current important standards (from any SDO) to your area that are in need of updating to support development, design, and licensing. Why are they your top five?

High Temperature Reactors	Molten Salt Reactors	Fast Reactors
• ASME/ANS RA-S-1.4-2013, PRA for Non-LWRs (trial use) • ANS-30.1, RIPB Principles and Methods (in development) • ANS-30.2, Categorization and Classification of SSCs (in development) • ANSI/ANS-53.1-2011 (R2016) MHR Design Process • ANSI/ISA 67.02.1-2014, Safety Related Instrument-Sensing Line Piping and Tubing • ASME BPVC, Sec III, Div. 5, and related codes for welds, piping, etc. • Potential revisions to ASTM standards consistent with code requirements	• ANS standards on research reactors (ANS-15.X) are the most important; these standards need to be reviewed to determine if changes are needed • ANS-30.1, RIPB Principles and Methods (in development) • ANS-30.2, Categorization and Classification of SSCs (in development) • ANSI/ANS-53.1-2011 (R2016) MHR Design Process • ASME Sec. III, Div. 5 • Inservice Inspection (ISI) in Sec. II, Div. 2, will be of interest as it is being revised technology neutral next year • Welding materials – ASTM and/or AWS may need to add; braising (like welding) may be needed • ASME Operation and Maintenance Code • ACI 349, Concrete Structures for high flux	• ASME NQA-1, Quality Assurance (design, construction, and operation) • ANS-3.2, Quality Assurance (managerial and administrative controls) • ANS-57.1, Design Requirements for Fuel Handling Systems • ANS-54.2 (withdrawn), Fast Breeder Reactor Spent Fuel Storage • ASME BPVC, Sec. III, Div. 5, for environmental effects (mainly corrosion), cladded structural materials • ASME BPVC, Sec. XI, to capture features specific to fast reactor technologies

3. List the five most important technical areas that need standards development (where they currently don't have standards). Why are they your top five?

High Temperature Reactors	Molten Salt Reactors	Fast Reactors
• RIPB "suite" • ASME BPVC, Sec. VIII, cyclic loads for high temp • Design life for ASME BPVC, Sec. VIII, and Sec. III, Div. 5 • Fiber optic (specifically) and qualification of I&C for high temp • ASME BPVC, Sec. XI, "fitness for service" high-temp failures ISI – team formed to evaluate	• Advanced manufacturing • Fuel salt purity • Radioactive material packaging, handling, shipping for products with salt residue; goal to reduce packaging. Tech neutral standard would be beneficial • Chemistry and corrosion control; inspection and testing for corrosion	• Source term assessment for non-LWRs (would support emergency planning zone size reduction) • Casks for shipping and dry-storage of high assay low-enriched uranium (LEU) • Startup testing and reliability measurement of passive safety systems. Note: highest priority is for reactor vessel auxiliary cooling systems (RVACS) (suggested to reach an industry-agreed method to assess RVACS and address it in licensing phase)

3. ***List the five most important technical areas that need standards development (where they currently don't have standards). Why are they your top five?***		
High Temperature Reactors	**Molten Salt Reactors**	**Fast Reactors**
		• Materials joining such as printed circuit heat exchangers (and diffusion bonding in general) and silicon carbide • Multi-use, inter-operability components—standardization of component interfaces to ease and increase level of modularity in construction • Additive manufacturing • Standards applicable to some specific features of micro-reactors for "niche" applications (e.g. remote control and security aspects) • Digital technology (e.g. use of off-the-shelf computer applications to standardize digital technology implementation)

4. ***Provide some prioritization of the two lists, both in overall need (must have to move forward) and in timing (need by a certain date). If possible, provide insights as to why the standard has priority and what aspect of the issues are driving the priority.***		
High Temperature Reactors	**Molten Salt Reactors**	**Fast Reactors**
1. RIPB-related standards 2. Everything else Sub-prioritized by what needs development, what needs revision, and/or what needs endorsement From question 2: 1. Any changes needed for RIPB licensing a) ASME/ANS RA-S-1.4-2013, PRA for Non-LWRs (trial use) b) ANS-30.1, RIPB Principles and Methods (in development) c) ANS-30.2, Categorization and Classification of SSCs (in development – related to LMP) d) ANSI/ANS-53.1-2011 (R2016) MHR Nuclear Safety Design	Felt it is too early to prioritize	Above list in question #3 is provided in decreasing order of importance

4. Provide some prioritization of the two lists, both in overall need (must have to move forward) and in timing (need by a certain date). If possible, provide insights as to why the standard has priority and what aspect of the issues are driving the priority.		
High Temperature Reactors	**Molten Salt Reactors**	**Fast Reactors**
2. ANSI/ISA 67.02.1-2014, Safety Related Instrument-Sensing Line Piping and Tubing 3. ASME BPVC, Sec. III, Div. 5, and related codes for welds, piping, etc. 4. Potential revisions to ASTM standards consistent with code requirements From question 3: 1. RIPB "suite" 2. Sec. VIII cyclic loads for high temp 3. Design life for Sec. VIII and Sec. III, Div. 5 4. Fiber optic (specifically) and qualification of I&C for high temp 5. Sec. XI "fitness for service" high-temp failures ISI – team formed to evaluate		

5. A) What cross-cutting issues do you believe need to be included in the development of new standards for advanced reactors or the updating of current standards? These could include analysis methods (like probabilistic risk assessment, thermal hydraulics, human factors, etc.) or other cross-cutting issues like staffing, emergency management, advanced instrumentation, and control, security, etc.		
High Temperature Reactors	**Molten Salt Reactors**	**Fast Reactors**
• All of the above (except for ANS-53.1, MHR Nuclear Safety Design) • Process/understanding of how to raise code issues and get them resolved quickly o Accelerating research and standards development o Application of demonstration/prototype approach • Recognition of/ideas for taking optimum credit for mod/sim vs. testing	• Emergency management less of a concern with safer advanced reactors • Standardization of material accountability control method • Intersection of human factors, simulation assisted engineering, tightly coupled I&C • Alarms management • Digital I&C, ISG-05 on highly integrated control room • Molten salt reactor safeguards • Test procedure and data format for characterization of salt	• High assay LEU fuel transportation/storage • Safety-significance-based classification of SSCs within ASME NQA-1 • Source term assessment (accounting for coolant-specific radionuclide retention capability; confinement vs. containment) • Passive systems analysis/qualification

5. B) Is there a preference across the advanced reactor industry that future advanced reactor standards be more performance based and use high-level, risk-informed principles compared to current standards? What should drive this decision?

High Temperature Reactors	Molten Salt Reactors	Fast Reactors

• Performance based?
  o Maintain existing top level regulatory criteria
  o Performance-based criteria as a more easily demonstrated metric to show we meet top level regulatory criteria is a good thing
  o LMP-type approach identifies what is important in terms of functional outcomes, other prescriptive "requirements" should not apply
  o Additional discussion needed to translate this concept (currently being applied at regulatory framework level) to standards level
• Risk informed?
  o Yes, within reason
  o Defense in depth is important, but so is knowing when "enough is enough"
• What is driver?
  o Ensuring effective/efficient licensing process through safety-focused review
  o Reducing cost of plant
  o Lack of meaningful deterministic safety framework for non-LWRs
	• Prefers performance-based standards over prescriptive standards
	• Prescriptive method recognized as needed in some cases
		• Key driver is cost
		• Recognized that RIPB is likely more onerous effort on the regulator
		• Standards should be outcome-focused to avoid need for design modifications to comply with overly prescriptive criteria

It was estimated that there are over 800 existing standards (current and withdrawn) but that very few people have a comprehensive knowledge of all standards. Participants were informed of a list of consensus standards used by the NRC that may be of interest. The list can be found on NRC's website at https://www.nrc.gov/about-nrc/regulatory/standards-dev/consensus.html.

6. Meeting Summary and Actions

Several standards and codes emerged as priorities between technology groups as candidates for updating and/or harmonization. Responsible SDOs are asked to follow up on the following standards and standards projects to insure their usefulness and availability to advanced reactors. It should be noted that TWG and stakeholder engagement will be necessary to adequately address needs.

American Society of Mechanical Engineers (ASME)

ASME NQA-1-2017, "Quality Assurance Requirements for Nuclear Facilities Applications"
ACTION: Examples of issues in applying NQA-1 to non-LWRs to be considered:

- Subpart 2.2 (QA Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Facilities). Concerns with classification levels (a, b, c, d) "based on important physical characteristics and not upon the important functional characteristics of the item with respect to safety, reliability, and operation."
- Subpart 2.5 (QA Requirements for Installation, Inspection, and Testing of Structural Concrete, Structural Steel, Soils, and Foundations for Nuclear Power Plants). Implicit assumptions on installation, inspection and testing of different concrete, steel, foundation, soil, earthwork, equipment and other items and their quality requirements regardless of importance to safety and based on LWR experience.
- Subpart 2.15 (QA Requirements for Hoisting, Rigging, and Transporting of Items for Nuclear Power Plants). Similar concerns on classifications based off of LWR experience for categories A-C.
- Subpart 2.20 (QA Requirements for Subsurface Investigations for Nuclear Power Plants). Possibly less critical, but subsurface QA requirements based on LWR experience and LWR importance to safety of the soil and seismic effects.

ASME Boiler Pressure Vessel Code, various sections (III, VIII, XI) and various divisions
ACTIONS: Areas to be considered for potential inclusion or update include:

- welds, piping, etc.
- inservice Inspection
- Construction rules
- environmental effects (corrosion)
- cladded structural materials
- Cyclic loads
- fitness for service
- design life
- additive manufacturing

American Nuclear Society (ANS)

ANS-30.1-201x, "Integration of Risk-Informed, Performance-Based Principles and Methods into Nuclear Safety Design for Nuclear Power Plants" (new standard in development)
ACTION: Completion of standard; harmonization with other standards and the LMP effort

ANS-30.2-201x, "Categorization and Classification of Structures, Systems, and Components for New Nuclear Power Plants" (new standard in development)
ACTION: Completion of standard; harmonization with other standards and the LMP effort

ANSI/ANS-53.1-2011 (R2016), "Nuclear Safety Design Process for Modular Helium-Cooled Reactor Plants"
ACTION: Review current standard for consistency with other standards and the LMP effort

Institute of Electrical and Electronics Engineers (IEEE)

IEEE I&C standards including IEEE Std. 603 and IEEE Std. 323 and the supporting standards
ACTION: Incorporate fiber optics and qualification to higher temperatures and different environments.

Other areas that emerged as topics for potential new standards, standards that may need to be revised, or general areas to be considered by SDOs are listed below. It should be noted that TWG and stakeholder engagement will be necessary to define or clarify specific needs to proceed.

American Concrete Institute

ACI 349-13, "Code Requirements for Nuclear Safety-Related Concrete Structures"
ACTION: Explore need for revision of current standard to address advanced reactors

American Nuclear Society

ANSI/ANS-3.2-2012 (R2017), "Managerial, Administrative, and Quality Assurance Controls for the Operational Phase of Nuclear Power Plants"
ACTION: Explore need for revision of current standard to address advanced reactors

ANS-15.X, Series of standards for research reactors
ACTION: Evaluate research reactor standards for applicability to advanced reactors

ANSI/ANS-18.1-2016, "Radioactive Source Term for Normal Operation of Light Water Reactors"
ACTION: Explore need for revision of current standard to address advanced reactors

ANSI/ANS-54.2-1985 (W1995), "Design Bases for Facilities for LMFBR Spent Fuel Storage in Liquid Metal Outside the Primary Coolant Boundary"
ACTION: Explore need for reinvigoration of historical standard to address advanced reactors

ANSI/ANS-57.1-1992 (R2015), "Design Requirements for Light Water Reactor Fuel Handling Systems"
ACTION: Explore need for revision of current standard to address advanced reactors
.

American Society of Mechanical Engineers (ASME)

ASME OM 2017, "Operation and Maintenance of Nuclear Power Plant Code"
ACTION: Explore need for revision of current code to address advanced reactors

American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS)

ASME/ANS RA-S-1.2-2014, "Severe Accident Progression and Radiological Release (Level 2) PRA Standard for Nuclear Power Plant Applications for Light Water Reactors (LWRs)"

ACTION: Trial use standard to be finalized and seek approval of the American National Standards Institute

American Society of Testing and Materials (ASTM)

ACTION: General suggestion to evaluate need for revisions to ASTM standards consistent with code (e.g., welding materials, brazing, reactive and refractory metals and alloys under the B10 Committee); also to explore standardization of additive manufacturing

American Welding Society

AWS welding/brazing standards
ACTION: Evaluate welding/brazing standards for potential need to update for advanced reactor use

International Society of Automation (ISA)

ANSI/ISA 67.02.1-2014, "Safety-Related Instrument Sensing Line Piping and Tubing Standard for Use in Nuclear Power Plants"
ACTION: Evaluate need for update of current standard for high temperature

Unassigned topical areas needing standardization for advanced reactors that may be taken up by the most appropriate SDO

- Performance-based standard for acceptance criteria (all SDOs)
- Advanced manufacturing
- Fuel salt purity
- Radioactive material packaging handling, and shipping for products with salt residue

Topics for future workshop discussions recognized include:

- Defense in depth
- Harmonization with LMP approach
- Acceleration of standards development; possible funding support to help
- Unique aspects related to seismic
- Reducing loads and structures

Miscellaneous actions:

- Prepare and group a list of existing standards (~860) in high-level categories to facilitate their identification and priority-based use
- Encourage more vendor and international participation at subsequent meetings and workshops
- All SDOs to reinforce industry preference for RIPB methods to be used when developing or updating a standard or code

American Nuclear Society

The next NRC Standards Forum will be scheduled for September of this year at NRC and was thought to be a good opportunity to continue discussions of need actions, prioritization, and next steps.

In closing, Steven Arndt expressed the sentiment that the workshop had great interaction and cooperation from all. He added that there were two main actions, they are to reach out to SDOs of standards that were identified and to reach out to the TWGs with the information gathered today to help establish the next steps.

7. Adjournment

Dr. Steven Arndt thanked all for participating before adjourning the workshop.

List of Attachments	
Attachment 1	Workshop Sign In Sheets
Attachment 2	Webinar Participation Reports
Attachment 3	Welcome/Logistic Presentation (ANS Standards Board Chair Steven Arndt)
Attachment 4	High Temperature Reactor TWG Presentation (Matthew Miller)
Attachment 5	Molten Salt Reactor TWG Presentation (Jason Redd)
Attachment 6	Fast Reactor TWG Presentation (Paolo Ferroni on behalf of Jason DeWitte)
Attachment 7	High Temperature Breakout Session Summary Presentation (Peter Hastings)
Attachment 8	Fast Reactor Breakout Session Summary Presentation (Paolo Ferroni)

ATTACHMENT 6

March 1, 1999

MEMORANDUM TO: William D. Travers
Executive Director for Operations

FROM: Annette L. Vietti-Cook, Secretary /s/

SUBJECT: STAFF REQUIREMENTS - SECY-98-144 - WHITE PAPER ON RISK-INFORMED AND PERFORMANCE-BASED REGULATION

The Commission has approved the issuance of the white paper which defines the terms and Commission expectations for risk-informed and performance-based regulation. The paper should be prepared for issuance by the Commission for use by the NRC and interested parties.

Attachment: As stated

cc: Chairman Jackson
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield
OGC
CIO
CFO
OCA
OIG
OPA
Office Directors, Regions, ACRS, ACNW, ASLBP (via E-Mail)
PDR
DCS

ATTACHMENT

Risk-Informed and Performance-Based Regulation

The NRC has established its regulatory requirements, in both reactor and materials applications, to ensure that "no undue risk to public health and safety" results from licensed uses of Atomic Energy Act (AEA) materials and facilities. The objective of these requirements has always been to assure that the probabilities of accidents with the potential for adversely affecting public health and safety are low. For reactors, these probabilities were not quantified in a systematic way until 1975 when the Reactor Safety Study (WASH-1400) was published. For non-reactor activities, the situation is more complex. In some areas, high-level waste disposal and transportation, risk assessment has been in use since the 1970s; in others, such quantification is still evolving. Consequently, most of NRC's regulations were developed without the benefit of quantitative estimates of risk. The perceived benefits of the deterministic and prescriptive regulatory requirements were based mostly on experience, testing programs and expert judgment, considering factors such as engineering margins and the principle of defense-in-depth.

There have been significant advances in and experience with risk assessment methodology since 1975. Thus, the Commission is advocating certain changes to the development and implementation of its regulations through the use of risk-informed, and ultimately performance-based , approaches. The Probabilistic Risk Assessment (PRA) Policy Statement (60 FR 42622, August 16, 1995) formalized the Commission's commitment to risk-informed regulation through the expanded use of PRA. The PRA Policy Statement states, in part, "The use of PRA technology should be increased in all regulatory matters to the extent supported by the state of the art in PRA methods and data, and in a manner that complements the NRC's deterministic approach and supports the NRC's traditional defense-in-depth philosophy."

The transition to a risk-informed regulatory framework is expected to be incremental. Many of the present regulations are based on deterministic and prescriptive requirements that cannot be quickly replaced. Therefore, the current requirements will have to be maintained while risk-informed and/or performance-based regulations are being developed and implemented.

To understand and apply the commitment expressed in the PRA Policy Statement, it is important that the NRC, the regulated community, and the public at large have a common understanding of the terms and concepts involved; an awareness of how these concepts (in both reactor and materials arenas) are to be applied to NRC rulemaking, licensing, inspection, assessment, enforcement, and other decision-making; and an appreciation of the transitional period in which the agency and industry currently operate.

1. Risk and Risk Assessment: This paper defines risk in terms that can be applied to the entire range of activities involving NRC licensed use of AEA materials. The risk definition takes the view that when one asks,

"What is the risk?" one is really asking three questions: "What can go wrong?" "How likely is it?" and "What are the consequences?" These three questions can be referred to as the "risk triplet." The traditional definition of risk, that is, probability times consequences, is fully embraced by the "triplet" definition of risk.

The first question, "What can go wrong?" is usually answered in the form of a "scenario" (a combination of events and/or conditions that could occur) or a set of scenarios.

The second question, "How likely is it?" can be answered in terms of the available evidence and the processing of that evidence to quantify the probability and the uncertainties involved. In some situations, data may exist on the frequency of a particular type of occurrence or failure mode (e.g., accidental overexposures). In other situations, there may be little or no data (e.g., core damage in a reactor) and a predictive approach for analyzing probability and uncertainty will be required.

The third question, "What are the consequences?" can be answered for each scenario by assessing the probable range of outcomes (e.g., dose to the public) given the uncertainties. The outcomes or consequences are the "end states" of the analyses. The choice of consequence measures can be whatever seems appropriate for reasonable decision-making in a particular regulated activity and could involve combinations of end states.

A risk assessment is a systematic method for addressing the risk triplet as it relates to the performance of a particular system (which may include a human component) to understand likely outcomes, sensitivities, areas of importance, system interactions and areas of uncertainty. From this assessment the important scenarios can be identified.

2. Deterministic and Probabilistic Analyses: All safety regulation ultimately is concerned with risk and addresses the three questions discussed in item 1 above. In practice, NRC addresses these three questions through the body of regulations, guidance, and license conditions that it uses to regulate the many activities under its jurisdiction. The current body of regulations, guidance and license conditions is based largely on deterministic analyses and **is** implemented by prescriptive requirements. As described in the PRA Policy Statement, the deterministic approach to regulation establishes requirements for engineering margin and for quality assurance in design, manufacture, and construction. In addition, it assumes that adverse conditions can exist and establishes a specific set of design basis events (i.e., what can go wrong?). The deterministic approach involves implied, but unquantified, elements of probability in the selection of the specific accidents to be analyzed as design basis events. It then requires that the design include safety systems capable of preventing and/or mitigating the consequences (i.e., what are the consequences?) of those design basis events in order to protect public health and safety. Thus, a deterministic analysis explicitly addresses only two questions of the risk triplet. In addition, traditional regulatory analyses do not integrate results in a comprehensive manner to assess the overall safety impact of postulated initiating events.

PRA and other risk assessment methods (also described in the PRA Policy Statement) consider~~s~~ risk (i.e., all three questions) in a more coherent, explicit, and quantitative manner. Risk assessment methodology examines systems and their interactions in a integrated, comprehensive manner. Probabilistic analysis explicitly addresses a broad spectrum of initiating events and their event frequency. It then analyzes the consequences of those event scenarios and weights the consequences by the frequency, thus giving a measure of risk.

Since risk assessment methods were first used to gain a better understanding of the risk associated with some of the activities and facilities that **the** NRC regulates, substantial event data and increased sophistication and experience in the use of certain risk assessment methods (e.g., Probabilistic Risk Assessment (PRA), Integrated Safety Assessment (ISA), and Performance Assessment (PA)) ha~~s~~**ve** been acquired. Accordingly, there is now the opportunity to enhance the traditional approach by more explicitly addressing risk and incorporating the insights thus gained.

While the traditional deterministic approach to regulation has been successful in ensuring no undue risk to public health and safety in the use of nuclear materials, opportunities for improvement exist. Given the broad spectrum of equipment and activities covered, the regulations can be strengthened and resources **can be** allocated to ensure that they are focused on the most risk-significant equipment and activities, and to ensure a consistent and coherent framework for regulatory decision-making. The different "risk-informed" and/or "performance-based" approaches to regulation described below, if properly applied singly or in combination, would provide such a framework.

3. "Risk Insights": The term "risk insights", as used here, refers to the results and findings that come from risk assessments. The end results of such assessments may relate directly to public health effects as in the Commission's Safety Goals for the Operations of Nuclear Power Plants. For specific applications the results and findings may take other forms. For example, for reactors these include such things as identification of dominant accident sequences, estimates of core damage frequency (CDF)[(1)] and large early release frequency (LERF)[(2)], and importance measures of structures, systems, and components. On the other hand, in other areas of NRC regulation, findings and results include risk curves[(3)] for disposal facilities for radioactive wastes, frequency of and costs associated with accidental smelting of sealed sources at steel mills, frequency of occupational exposures, predicted dose from decommissioned sites and many others.

   Risk insights have already been incorporated successfully into numerous regulatory activities, and have proven to be a valuable complement to traditional deterministic approaches. Given the current maturity of some risk assessment methodologies and the current body of event data, risk insights can be incorporated more explicitly into the regulatory process in a manner that will improve both the efficiency and effectiveness of current regulatory requirements.

4. "Risk-Based Approach": Regulatory decision-making is required in both the development of regulations and guidance and the determination of compliance with those regulations and guidance. A "risk-based" approach to regulatory decision-making is one in which such decision-making is solely based on the numerical results of a risk assessment. This places heavier reliance on risk assessment results than is currently practicable for reactors due to uncertainties in PRA such as completeness. Note that the Commission does not endorse an approach that is "risk-based"; however, this does not invalidate the use of probabilistic calculations to demonstrate compliance with certain criteria, such as dose limits.

5. "Risk-Informed Approach **"**: A "risk-informed" approach to regulatory 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: (a) allowing explicit consideration of a broader set of potential challenges to safety, (b) providing a logical means for prioritizing these challenges based on risk significance, operating experience, and/or engineering judgment, (c) facilitating consideration of a broader set of resources to defend against these challenges, (d) explicitly identifying and quantifying sources of uncertainty in the analysis (although such analyses do not necessarily reflect all important sources of uncertainty), and (e) leading to better decision-making by providing a means to test the sensitivity of the results to key assumptions. Where appropriate, a risk-informed regulatory approach can also be used to reduce unnecessary conservatism in purely deterministic approaches, or can be used to identify areas with insufficient conservatism in deterministic analyses and provide the bases for additional requirements or regulatory actions. "Risk-informed" approaches lie between the "risk-based" and purely deterministic approaches. The details of the regulatory issue under consideration will determine where the risk-informed decision falls within the spectrum.

6. Risk-Informed **Approach** and Defense-in-Depth ~~Approach~~: The concept of defense-in-depth[(4)] has always

been and will continue to be a fundamental tenet of regulatory practice in the nuclear field, particularly regarding nuclear facilities. Risk insights can make the elements of defense-in-depth more clear by quantifying them to the extent practicable. Although the uncertainties associated with the importance of some elements of defense may be substantial, the fact that these elements and uncertainties have been quantified can aid in determining how much defense makes regulatory sense. Decisions on the adequacy of or the necessity for elements of defense should reflect risk insights gained through identification of the individual performance of each defense system in relation to overall performance.

7. "Performance-Based Approach": A regulation can be either prescriptive or performance-based. A prescriptive requirement specifies particular features, actions, or programmatic elements to be included in the design or process, as the means for achieving a desired objective. A performance-based requirement relies upon measurable (or calculable) outcomes (i.e., performance results) to be met, but provides more flexibility to the licensee as to the means of meeting those outcomes. A performance-based regulatory approach is one that establishes performance and results as the primary basis for regulatory 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. The measurable (or calculable) parameters may be included in the regulation itself or in formal license conditions, including reference to regulatory guidance adopted by the licensee. This regulatory approach is not new to the NRC. For instance, the Commission previously has approved performance-based approaches in 10 CFR Parts 20, 50 (Option B, Appendix J and the Maintenance Rule,10 CFR50.65) **,** 60, and 61. In particular, the Commission weighed the relative merits of prescriptive and performance-based regulatory approaches in issuing 10 CFR Part 60.

   A performance-based approach can be implemented without the use of risk insights. Such an approach would require that objective performance criteria be based on deterministic safety analysis and performance history. This approach would still provide flexibility to the licensee in determining how to meet the performance criteria. Establishing objective performance criteria for performance monitoring may not be feasible for some applications and, in such cases, a performance-based approach would not be feasible.

   As applied to inspection, a performance-based approach tends to emphasize results (e.g., can the pump perform its intended function?) over process and method (e.g., was the maintenance technician trained?). Note that a performance-based approach to inspection does not supplant or displace the need for compliance with NRC requirements, nor does it displace the need for enforcement action, as appropriate, when non-compliance occurs.(5)

   As applied to licensee assessment, a performance-based approach focuses on a licensee's actual performance results (i.e., desired outcomes), rather than on products (i.e., outputs). In the broadest sense, the desired outcome of a performance-based approach to regulatory oversight will be to focus more attention and NRC resources on those licensees whose performance is declining or less than satisfactory.

8. "Risk-Informed, Performance-Based **Approach**": A risk-informed, performance-based approach to regulatory decision-making combines the "risk-informed" and "performance-based" elements discussed in Items ~~3~~ **5** and – ~~6~~ **7**, above, and applies these concepts to NRC rulemaking, licensing, inspection, assessment, enforcement, and other decision-making. Stated succinctly, a risk-informed, performance-based regulation 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, (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 regulatory decision-making.

The definitions and concepts in this paper have proven suitable for application to nuclear power plants and certain non-reactor activities (e.g., PA of geologic repositories). While different in detail, these activities are similar in terms of system complexity and the application of probabilistic methods to the determination of safety. In simpler situations, the concepts and definitions should prove equally suitable provided that NRC adopts a flexible framework for the implementation of risk-informed, and ultimately performance-based , regulation across the full spectrum of the materials, processes, and facilities regulated by the NRC.

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1. CDF is the frequency of the combinations of initiating events, hardware failures, and human errors leading to core uncovery with reflooding of the core not imminent.

2. LERF is the frequency of those accidents leading to significant, unmitigated releases from containment in a time-frame prior to effective evacuation of the close-in population such that there is a potential for early health effects.

3. Risk curves (also known as Complementary Cumulative Distribution Functions (CCDFs) or Farmer curves) are estimates of the probability that a given consequence will be exceeded.

4. Defense-in-depth is an element of the NRC's Safety Philosophy that employs successive compensatory measures to prevent accidents or mitigate damage if a malfunction, accident, or naturally caused event occurs at a nuclear facility. The defense-in-depth philosophy ensures that safety will not be wholly dependent on any single element of the design, construction, maintenance, or operation of a nuclear facility. The net effect of incorporating defense-in-depth into design, construction, maintenance, and operation is that the facility or system in question tends to be more tolerant of failures and external challenges.

5. Not every aspect of licensed activities can or should be inspected using this approach. For example, if a licensee is unsuccessful in meeting the criteria defined by a performance-based regulation, the inspector should then focus on the licensee's process and method, to understand the root cause of the breakdown in performance, and to understand how future poor performance may be avoided.

ATTACHMENT 7

Schedule of ANS Standards in Development using RIPB Properties (June. 2018)

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-2.8 (Y. Gao) / *ESCC (C. Mazzola) Determine External Flood Hazards for Nuclear Facilities JCNRM Rep: V. Anderson, R. Schneider			Ballot Closed 8-30-16	Aug - Nov 2018	Dec 2018	Dec 2018	Apr 2019
	Note: Working group resolving ballot comments and late NRC comments. Significant changes being made to the draft. May need full reballot with additional time for comment resolution.						
ANS-2.22 (T. Jannik)/*ESSC (C. Mazzola) Environmental Radiological Monitoring at Operating Nuclear Facilities JCNRM Rep:	May 2019	Jun - Sept 2019	Oct -Mar 2020	Apr - Jul 2020	Aug 2020	Aug 2020	Dec 2020
ANS-2.26 (Q. Hossain & D.Clark) /*ESCC (C. Mazzola) Categorization of Nuclear Facility SSCs for Seismic Design JCNRM Rep:	A PINS is in development for a revision. Schedule TBD.						
ANS-2.27 (K. Hanson)/*ESCC (C. Mazzola) Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments JCNRM Rep:	Sept 2019	Oct - Jan 2020	Feb - July 2020	Aug - Nov 2020	Dec 2020	Dec 2020	Apr 2021
ANS-2.29 (E. Gibson)/*ESCC (C. Mazzola) Probabilistic Seismic Hazard Analysis JCNRM Rep: A. Kammerer	Sept 2019	Oct - Jan 2020	Feb - July 2020	Aug - Nov 2020	Dec 2020	Dec 2020	Apr 2021
ANS-3.8.7 (R. Markovich) / *LLWRCC (G. Carpenter) Properties of Planning, Development, Conduct, and Evaluation of Drills and Exercises for Emergency Preparedness at Nuclear Facilities JCNRM Rep:	On hold -- consideration of redirection for new non-LWR reactors						
ANS-3.13 (J. August) / *LLWRCC (G. Carpenter) Nuclear Facility Reliability Assurance Program (RAP) Development JCNRM Rep:	Project plan in development to re-establish path forward.						
ANS-3.14 (T. Anselmi & C. McMullin)/*NRNFCC (J. O'Brien) Process for Aging Management and Life Extension of NRNF JCNRM Rep: J. O'Brien	Jun 2018	Jul - Oct 2018	Nov - Apr 2019	May - Aug 2019	Sept 2019	Sept 2019	Jan 2020
ANS-20.1 (E. Blandford) / *RARCC (G. Flanagan) Nuclear Safety Design Criteria for Fluoride Salt-Cooled High-Temperature NPPs JCNRM Rep: R. Bari, R. Budnitz	Nov 2018	Dec - Mar 2019	Apr - Sept 2019	Oct - Jan 2020	Feb 2020	Feb 2020	Jun 2020
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:	Nov 2018	Dec - Mar 2019	Apr - Sept 2019	Oct - Jan 2020	Feb 2020	Feb 2020	Jun 2020
ANS-30.1 (M. Linn) / *RARCC (G. Flanagan) Risk-Informed & Performance-Based NPP Design Process JCNRM Rep: D. Johnson/K. Fleming/A. Maioli	Nov 2018	Dec - Mar 2019	Apr - Sept 2019	Oct - Jan 2020	Feb 2020	Feb 2020	Jun 2020
ANS-30.2 (A. Afzali) / *RARCC (G. Flanagan) Categorization Classification of SSCs for New Nuclear Power Plants JCNRM Rep: R. Grantom	Project on hold awaiting determination of path forward with evaluation on the Licensing Modernization Project.						

Schedule of ANS Standards in Development using RIPB Properties (June. 2018)

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-30.3 (K. Welter)/*LLWRCC (G. Carpenter) Advanced Light-Water Reactor Risk-Informed Performance-Based Design Criteria and Methods JCNRM Rep:	Sept 2019	Oct - Jan 2020	Feb - July 2020	Aug - Nov 2020	Dec 2020	Dec 2020	Apr 2021
ANS-54.1 (G. Flanagan) / *RARCC (G. Flanagan) Nuclear Safety Criteria & Design Process for Liquid-Sodium-Cooled NPPs JCNRM Rep: R. Budnitz		Ballot closed 8/5/17	Jan - Jun 2018	Jul - Oct 2018	Nov 2018	Nov 2018	Mar 2019
	A copy of the draft provided to SCoRA on 2/6/18.						
ANS-57.2 (R. Browder) / *FWDCC (D. Hillyer) Design Requirements for LWR Spent Fuel Storage Facilities at NPPs JCNRM Rep:	Mar 2020	Apr-Jul 2020	Aug 2020-Jan 2021	Feb-May 2021	Jun 2021	Jun 2021	Oct 2021
ANS-57.11 (B. Eble) / *NRNFCC (J. O'Brien) ISAs for Nonreactor Nuclear Facilities JCNRM Rep:	June 2019	Jul-Oct 2019	Nov-Apr 2020	May-Aug 2020	Sept 2020	Sept 2020	Jan 2021
ANS-58.8 (H. Liao)/*LLWRCC (G. Carpenter) Time Response Design Criteria for Safety-Related Operator Actions JCNRM Rep:	Apr 2020	May-Aug 2020	Sept 2020-Feb 2021	Mar-Jun 2021	Jul 2021	Jul 2021	Nov 2021

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*= ANS responsible 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