



# Risk-Informed Performance-Based Guidance Document Training (Overview)

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# Training Objective

- Provide knowledge to writers of ANS standards that will assist them in incorporating Risk-Informed Performance-Based (RIPB) attributes in their ANS standards.
- Do this by providing training on ANS Guidance Document, [Incorporating Risk-Informed and Performance-Based Approaches/Attributes in ANS Standards.](#)

# Overview of Guidance

## **Guidance has the following major sections:**

- Purpose of guidance
- Background
- Process
- Objectives of RIPB standards
- Attributes of RIPB standards

## **Guidance has the following appendices**

- Roles and responsibilities
- Background
- Example of simplistic RIPB application
- Examples of RIPB attributes in ANS standards
- FAQs

# Objectives of Standards

## Why write a standard?

- To establish requirements (“shall” statements) that, taken together, drive a user to accomplish one or more outcomes.
- “Should” statements provide recommendations and additional guidance (not requirements) to the user.
- The user of a standard – and, ideally, authorities having approval authority over the user’s work product - will have a high level of confidence that the outcomes will be accomplished if the “shall” requirements are met.

## Clear Outcome

The clear statement of the ultimate outcomes called for in a standard is a critical step.

*RIPB standards can achieve these outcomes more efficiently.*

# Objectives for Risk-Informed Standards

**Risk-informed insights can be used to support decisions on the scope, focus, level of rigor, and/or complexity of the standard.**

## **Risk Insights to define the scope of the standard**

- e.g., to identify only those program elements or structures, systems, and components (SSCs) that are the more important (from a risk perspective) to achieve the desired outcome(s).

## **Using risk metrics as part of the standard's outcome statement**

- The outcome of the standard can be stated in terms of risk metrics such as the “frequency of a given consequence.”

# Objectives for Risk-Informed Standards (Cont'd)

## Using risk insights to define how to meet the standard's outcome

- Risk insights can provide a perspective on defining the rigor or level of effort to be used in meeting the outcomes called for in a standard.
- For example, risk insights can help to set requirements for the testing, surveilling, or inspecting SSCs (periodicity or type of testing). Risk insights can tell you what the desired performance (e.g., reliability) is. Then, given the desired performance, you can reason about testing etc.

# Objectives for Performance-Based Standards

Performance-based standards use an approach that focuses on desired, measurable performance outcomes, rather than prescriptive processes, techniques, or procedures.

- What performance aspect do we truly care about? Can we ascertain it directly and reliably?
  - Knowing the outcomes bypasses a lot of work. If you can't know the outcomes, you can still let standards users figure out how to determine what current performance is.
  - If you know whether a system is working (“performing”), that's better than having 50 PhDs sign off on QA.

# Objectives for Performance-Based Standards (Cont'd)

- Depending upon the specific outcome to be achieved, different levels of prescription on how to achieve that outcome may be appropriate.
  - If there's really only one way to do it right, you can prescribe that way.
    - Example: More prescription: Outcome – correct decay heat calculation
  - If there are lots of ways to do it right, let the user pick one.
    - Example: Less prescription: Outcome – not exceeding an occupational radiological exposure limit
- Level of detail – “shall” versus “should” versus “may”
- Two steps
  - Define the approach (major steps) to obtaining the outcome
  - Determine whether there are alternative approaches for achieving the outcome



# Key RIPB Attributes

## Risk-Informed Attributes

- R1. Use risk insights to define the scope of the standard.
- R2. Use risk insights (quantitative or qualitative) to define the level of prescription or rigor needed to achieve the outcome.
- R3. Define the desired outcome in terms of quantitative or qualitative risk metrics.

## Performance-Based Attributes

- P1. The outcome of the standard is clearly defined.
- P2. The criteria that are established to achieve the outcome are high level (i.e., provide flexibility in the manner in which the criteria is measured and to determine the “successful” level of the metrics).

# Appendix B Example NRC Regulatory Application: Maintenance Rule (10 CFR 50.65.)

## Outcome

- *[licensees] shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that these structures, systems, and components are capable of fulfilling their intended functions*

## Questions

- What are the elements of the outcome and are they clearly defined (Attribute P1)?
  - Are licensee-established goals clear at the function, system, sub-system, and component levels?

# Maintenance Rule

## Directions for Meeting the Outcome

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

## Questions

- Are the criteria that are established to achieve the outcome written at a high-level (Attribute P2) to provide flexibility?
- Does the Rule define how to develop the risk insights, e.g., the importance of inputs or steps used in achieving the outcome? (Attribute R1)
- Does the Rule define how to use risk insights? (Attribute R2)

# Maintenance Rule

## Questions

- Is the outcome of the Rule clearly defined.
- Are the criteria that are established to achieve the outcome written at a high level?
- Does it define how to develop the risk insights (e.g., the importance of inputs or steps used in the standard)?
- Does it define how to use risk insights?

# Appendix C: Simplified Example.

## *Cutting a long piece of aluminum bar*

### Performance-Based Discussion

Suppose ANS had a standard whose objective was cutting a long piece of aluminum bar and then measuring its length using a household tape measure. Further, suppose that this is accomplished by a sequence of prescriptive “shall” requirements, with “how to do it” specification for each cutting and each measuring step. Assume for the moment that the authors of the standard had in mind that, if the requirements are followed, the length of each piece would be measured to be, at a target length, within a tolerance of  $+1/16^{\text{th}}$  of an inch.

# Appendix C: Simplified Example.

## *Cutting a long piece of aluminum bar*

### *(Cont'd)*

The pros and cons of a “prescriptive” approach are evident in the above example. The principal “pro” is that the standard is simple and easily implemented. From a risk-informed perspective, the assumptions involved offer no basis for assessing the accuracy and precision (i.e., uncertainty) of the resulting product. Employing the product in an application represents the outcome of the standard. Hence, the “con” of the standard is that the outcome is unknowable by the user of the standard without more information. The desired performance-based outcome attribute of incentivizing improved outcomes cannot be realized.

# Appendix D: Examples of Risk-Informed Performance-Based Attributes in ANS Standards

## Type of Standard

- Design basis event definition
- Design analysis
- Process

# ANS-2.26 Categorization of Seismic Design

## Type of Standard

Design basis event definition

## Outcome

- *This standard provides (a) criteria for selecting the seismic design category (SDC) for nuclear facility SSC) to achieve earthquake safety and (b) criteria and guidelines for selecting Limit States for these SSCs to govern their seismic design. The Limit States are selected to ensure the desired safety performance in an earthquake.*



# ANS-2.26 Categorization of Seismic Design (Cont'd)

## Question

- Is the outcome of the standard clearly defined? (Attribute P1)

## Answer

- Kind of -- In simple terms, the outcome could be stated to be:

“The outcome of the use of this standard is the identification of the SDC and Limit States for SSCs to achieve earthquake safety.”

# ANS-2.26 Categorization of Seismic Design (Cont'd)

## Directions for Meeting the Outcome

- *One of the SDCs listed in Table 1 shall be assigned to the SSCs based on the unmitigated consequences that may result from the failure of the SSC by itself or in combination with other SSCs.*
- *Following determination of the regulatory requirements applicable to the project or to the facility, a safety analysis or integrated safety analysis shall be performed. The guidelines provided in this standard and other applicable standards such as Refs. [4] and [5] should be used.*
- *To achieve the objectives of this standard, the safety analyses shall evaluate the uncertainties with determining failure and the consequences of failure. The depth and documentation of the uncertainty analyses should be sufficient to support the judgment that categorization based on Table 1 and the design requirements in ANSI/ASCE/SEI 43-05 produce a facility that is safe from earthquakes.*

# ANS-2.26 Categorization of Seismic Design (Cont'd)

## Questions

- Are the criteria that are established to achieve the outcome written at a high-level (Attribute P2) to provide flexibility in achieving it?
- Does it define how to develop the risk insights, e.g., the importance of inputs or steps used in the standard? (Attribute R1)
- Does it define how to use risk insights? (Attribute R2)

# ANS-2.26 Categorization of Seismic Design (Cont'd)

## Answer (high-level criteria)

- Yes and No
  - ANS-2.26 provides high-level criteria that provides what needs to be done.
  - It also has very detailed prescriptive criteria and also invokes other consensus standards that provide very prescriptive criteria for the design of safety SSCs.

# ANS-2.26 Categorization of Seismic Design (Cont'd)

## Answer (how to develop risk insights)

- Yes
  - *One of the SDCs listed in Table 1 shall be assigned to the SSCs **based on the unmitigated consequences** that may result from the failure of the SSC by itself or in combination with other SSCs.*

# ANS-2.26 Categorization of Seismic Design (Cont'd)

## Answer (how to use risk insights)

- Yes
  - *The scope and comprehensiveness of the safety analysis will vary with the complexity of the facility, its operations, and the contained hazard. The assignment of an SDC to an SSC determined to have a safety function is based on the objective of achieving acceptable risk to the public, the environment, and workers resulting from the consequences of failure of the SSC.*
- This criteria specifies that a higher SDC will be assigned to SSCs whose failure would have greater consequences.

# Summary/Take Aways

- ANS is promoting the use of RIPB approaches in ANS standards.
- Guide is intended as a tool for consensus committees and working groups.
- Early RP3C engagement is encouraged.

# Additional Training

- Go through more examples in the Guidance Document in more detail
- Go through one or two standards the class recommends to look through



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# Backup Slides

- Backup slides follow

# RIPB Background

## Commission's Definitions of RIPB (SRM to SECY-98-144, RIPB White Paper)

- **Risk-Informed Approach**
  - Explicit consideration to a broader set of challenges
  - Logical prioritization of challenges
  - Consideration of broader set of resources to defend against challenges
  - Explicitly identifying and quantifying sources of uncertainty
  - Better decision making by testing for sensitivity to key assumptions
- **Performance-Based Approach**
  - Measurable (or calculable) parameters for monitoring
  - Objective criteria to assess performance
  - Flexibility to meet performance criteria for improved outcomes
  - Failure to meet criterion does not lead to immediate safety concern

# Outcome Attributes of Risk-Informed Safety

A “risk-informed” approach to safety decision-making represents a philosophy whereby risk insights are considered together with other factors to establish requirements that better focus licensee and regulatory attention on design and operational issues commensurate with their importance to public health and safety.

A "risk-informed" approach enhances the deterministic approach by: (1) allowing explicit consideration of a broader set of potential challenges to safety, (2) providing a logical means for prioritizing these challenges based on risk significance, operating experience, and/or engineering judgment, (3) facilitating consideration of a broader set of resources to defend against these challenges, (4) explicitly identifying and quantifying sources of uncertainty in the analysis (although such analyses do not necessarily reflect all important sources of uncertainty), and (5) leading to better decision-making by providing a means to test the sensitivity of the results to key assumptions. Here, “prioritization” is key; while “risk-informed” means, in part, “not relying purely on the PRA,” it also means being able to say that some scenarios or systems are more important than others and understanding how sure we are about the statements we are making.

[Ref 1, SRM-SECY-98-0144]

# Outcome Attributes of Performance-Based Safety

**A performance-based safety approach is one that establishes performance and results as the primary basis for safety decision-making and incorporates the following attributes:**

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

[Ref 1, SRM-SECY-98-0144].

# History / Process

# Guidance Document Appendix A: Roles and Responsibilities

## **ANS Standards Board (SB)**

Approve the Guidance Document and promote its use within all consensus committees

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

Assign responsibilities to maintain the Guidance Document

Assign responsibilities of members for review of new and revised standards

## **Consensus Committee (CC) Chairs**

Support awareness of and implementation of this Guidance Document throughout the various stages of development of new and revised standards

## **Working Group (WG) Chairs**

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

# Guidance Document Appendix B: Background on RIPB Approaches (NRC Policy)

NRC Policy/Document (SECY 98-0144) Staff Requirements Memorandum SECY-98-0144, “White Paper on Risk-Informed and Performance-Based Regulation,” March 1, 1999, U.S. Nuclear Regulatory Commission.

- Definition of the RIPB approach:  
*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*
- Outcome Attributes of Risk-Informed Safety:  
A “risk-informed” approach to safety decision-making represents a philosophy whereby risk insights are considered together with other factors to establish requirements that better focus licensee and regulatory attention on design and operational issues commensurate with their importance to public health and safety.
- Application in regulations: In SRM-SECY-98-0144 [B.1] the NRC (at the Commission level) provided characteristic attributes and expected outcomes of **applying** RIPB approaches in regulations. The importance of this document for ANS lies in the fact that it can be invoked to request endorsement of a standard by the NRC staff.



# Background

- RP3C formed in 2013.
- RP3C Bylaws includes a task for developing RIPB Plan/Procedure for standards to utilize RIPB approaches.
- For some standards, the incorporation of a RIPB approach/attributes will make them even more effective for the user community to achieve the standard's desired outcome(s).
- First For Trial-Use Guidance Document issued on June 11, 2019.
- Second For Trial-Use Guidance Document issued on March 28, 2022.

# Lessons Learned and Improvements from 1<sup>st</sup> Version

- Feedback from training session
- Detailed review by JCRNM
- Major changes
  - Changes attributes section to objectives of a RIPB standard
  - Added new section on attributes of a RIPB standard
  - Modified key RIPB attributes/objectives table
  - Added an appendix on simplistic example of application of RIPB approach
  - Added a FAQ appendix
- Other changes
  - Moved roles and responsibilities to an appendix

# Purpose

- Identify the process for using RIPB approaches, when developing or revising American Nuclear Society (ANS) standards.
- Help the CCs, subcommittees (SubCs), and WGs decide if and how RIPB approaches can be incorporated into their standards.

# Background

- In 2013, the SB commissioned the RP3C ...  
*to establish “approaches, priorities, responsibilities, and schedules for implementation of risk-informed and performance-based principles in ANS standards.”.*
- The RP3C was then tasked by the SB to develop a plan ...  
*which would provide the approaches and procedures to be used by ANS Standards Committee CCs, SubCs, and WGs to implement RIPB principles in a consistent manner.*

# RIPB Guidance Process

## WG Formation and Project Initiation Notification System (PINS) Stage

- Consider recruiting a professional with experience in RIPB to be a part of the WG
- Consider a training session on this Guidance Document for all WG members
- Note: this will support answering the following PINS Form question
  - *Will this standard use RIPB requirements and/or a graded approach?*

# RIPB Guidance Process (Cont'd)

## Early Outlines/Draft

- Use this Guidance Document (particularly Section 5) to support incorporation of RIPB approaches into the standard.
- Reach out to the RP3C Chair for support

## Pre-Subcommittee Draft

- Send the draft standard to the RP3C for review by the RP3C
  - Note: Might be difficult at this stage to implement RP3C recommendations

