ANS RIPB Community of Practice

A Performance-Based Approach for 10 CFR Part 53

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Getting from where we are… … to where we need to be.

Questions

1. Why should NRC use a performance-based (PB) approach for Part 53?
2. Why is the current rule not a PB rule?
3. How can it be made PB?
4. What does success look like?

Answers

1. A PB approach is required by legislation and would be truly transformative.
2. The current Part 53 language could be PB where it is prescriptive.
3. NRC should incorporate longstanding Commission policy and guidance to eliminate unnecessary prescription.
4. A successful Part 53 will provide flexibility as well as encourage and reward improved safety outcomes.

Reg History: NRC Strategic Assessment and Re-baselining in late 1990s

- Commission's strategic initiatives led to identification of Direction Setting Issues (DSIs).
- DSI-12 on "Risk-Informed and Performance-Based Regulation" (RIPB).
- SRM-SECY-98-0144, "White Paper On Risk-Informed and Performance-Based Regulation."

- This was a far-reaching initiative undertaken prior to issuance of the NRC's first Strategic Plan.
- NRC staff identified about fifteen DSIs and prepared strategy papers for each.
- DSI-12 addressed lessons learned from many activities, including the PRA Policy Statement and the Maintenance Rule (considered to be performance-oriented).
- SRM for White Paper "defines the terms and Commission expectations for RIPB regulation" (ML003753601) and formally defines a PB approach.

White Paper Definition of PB Approach

The Commission has clearly identified the success attributes of employing a PB approach.

A successful relationship between the regulator and the regulated community would aspire to realize the Commission's vision.

- Sets up contrast between prescription and PB.
  - Prescription often produces unnecessary requirements.
- PB relies on outcomes.
  - White Paper PB approach outcome objectives are sufficiently clear.
- Key outcome objective is for a framework that avoids safety concerns.
  - Avoiding safety concerns requires working with margins rather than binary logic.
- Encourages and rewards improved outcomes.
  - Requires working with margins to use flexibility and improve safety through innovation.

What is the Imperative for a PB Approach?

Identify the success attributes.

Hold the implementation process accountable to delivering the success attributes.

- Envisioning success
  - Concept of success can be envisioned over a wide range of levels of detail.
- Clarity of outcome
  - Outcomes can be depicted with more clarity and transparency.
- More direct observation of cause-effect relationships
  - Easier to find qualitative-quantitative constructed parameters for decision-making.
- Better enables enterprise requirements management
  - Avoiding unnecessary regulatory requirements.

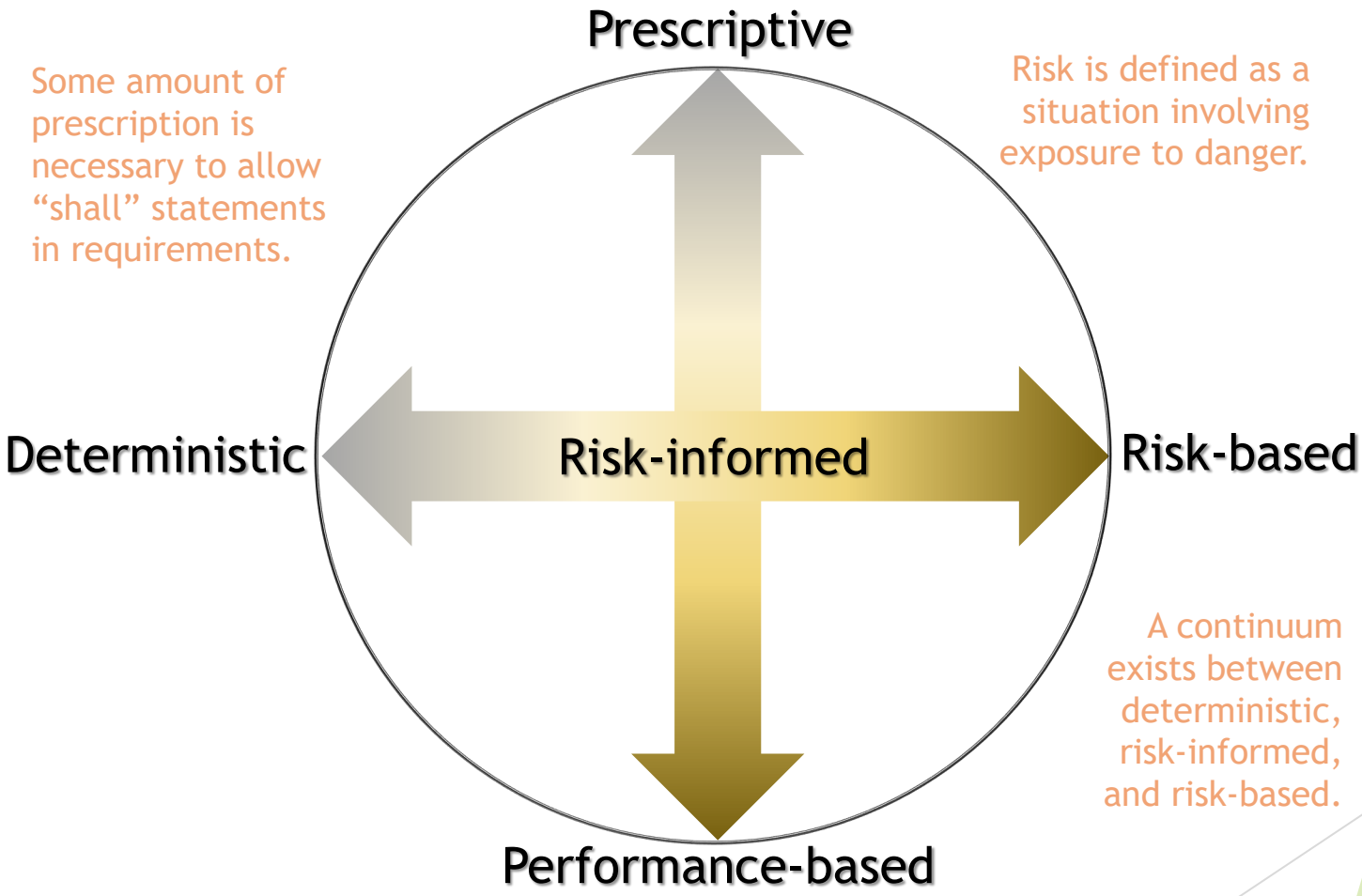
The Statutory Imperative

The Nuclear Energy Innovation and Modernization Act (NEIMA) contains provisions that require PB approaches to regulation.

NEIMA addresses requirements for existing and new technologies.

- "Technology-inclusive framework"
  - Outcomes that "allow innovation" and are "flexible and practicable" require consideration of margins to achieve success.
- "RIPB evaluation and guidance"
  - Defining what this provision means implies that the White Paper definitions are used.
- "Risk-informed licensing"
  - Including concept of margins for RIPB evaluation and guidance within the existing regulatory framework is needed for efficiency in decision-making.
- Margins approach better suited to meet varied considerations of NEIMA.
  - More margin = More flexibility

Regulatory Approaches

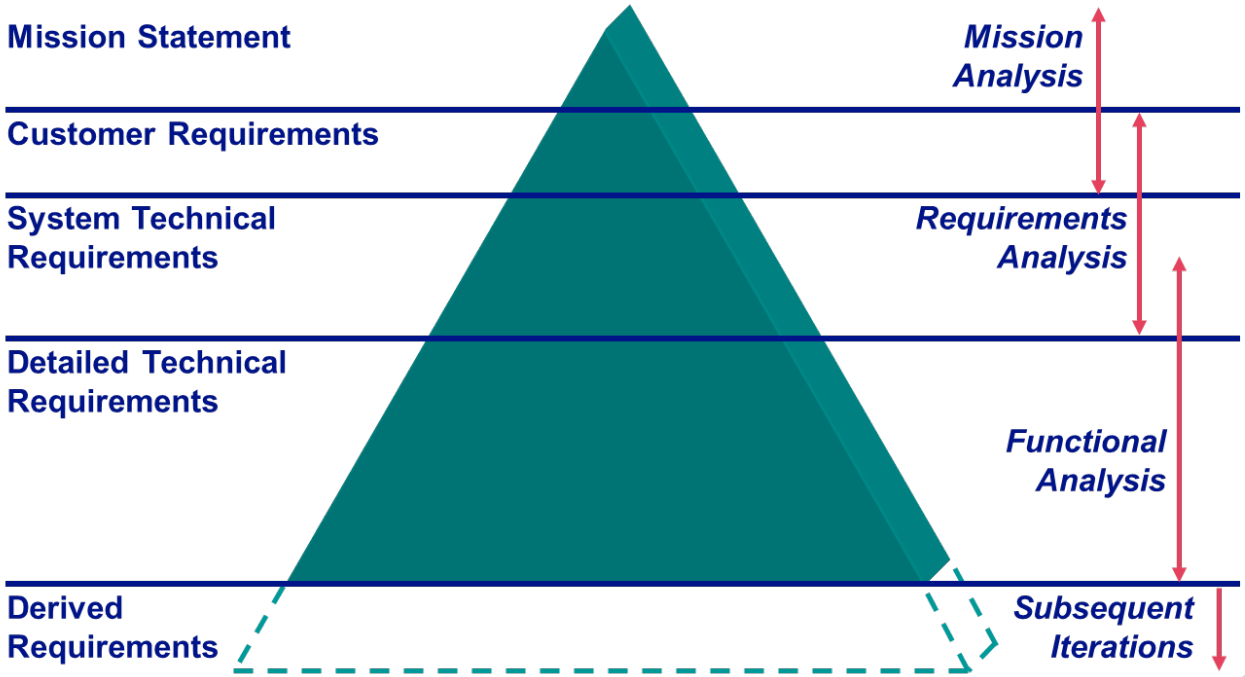


Some amount of prescription is necessary to allow "shall" statements in requirements.

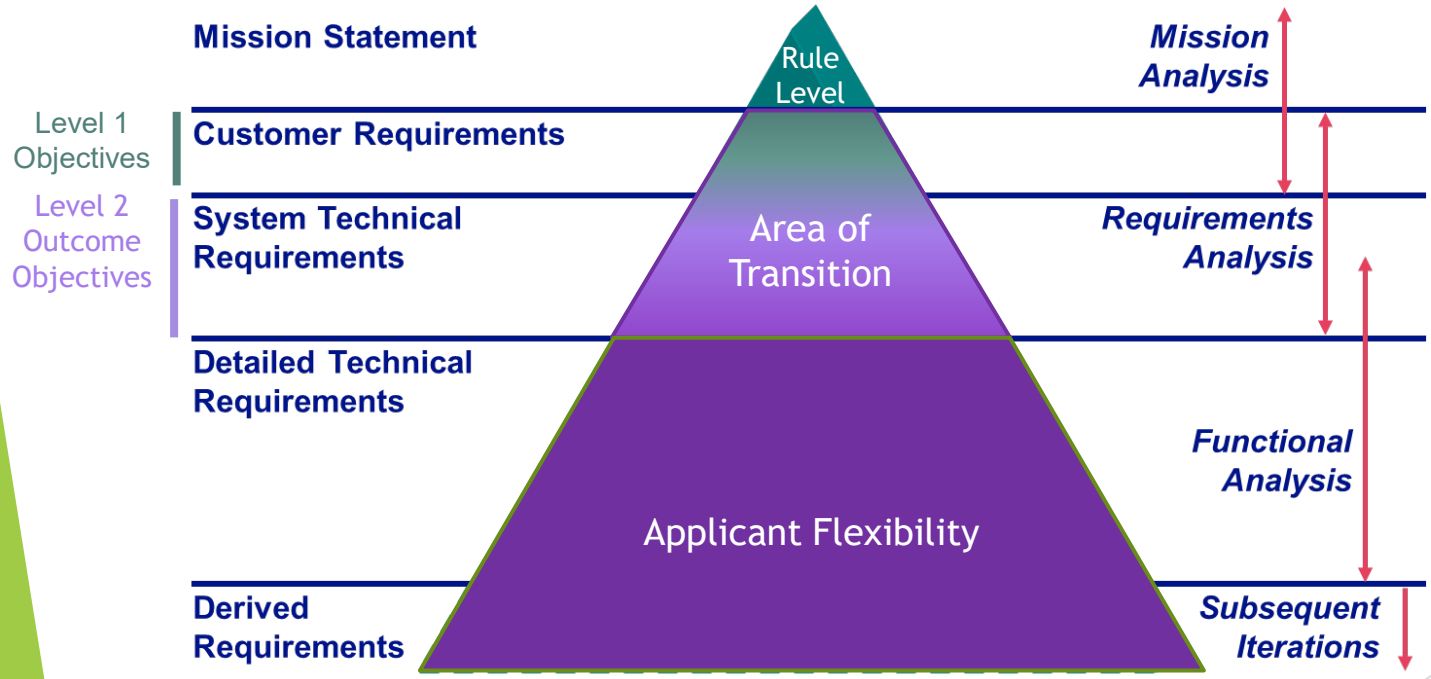
Risk is defined as a situation involving exposure to danger.

A continuum exists between deterministic, risk-informed, and risk-based.

Typical Structure for Requirements Management



Structure for Part 53 Requirements Management



NUREG/BR-0303, "Guidance for PB Regulation"

NUREG/BR-0303 closed out Staff action item from Commission to produce PB guidance.

Provides framework to meet White Paper PB definition.

Outlines a process applicable across all regulatory topics.

- Was subjected to three case studies, published for public comment, discussed at a public workshop, and reviewed by ACRS prior to issuance to the Commission.
- Supporting research was published in NUREG/CR-5392 and NUREG/CR-6833.
- Provides high-level PB guidelines for all NRC regulatory arenas.
- Treats reactor-related application separately in Appendix B.
- Addresses ACRS recommendations to
  - locate performance criteria at as high a level as practicable, and
  - address defense-in-depth within the structure of performance objectives.

NUREG/BR-0303, "Guidance for PB Regulation" [continued]

NUREG/BR-0303 offers guidelines for viability of PB approach, regulatory assessments, and regulatory principles.

Provides framework to meet ACRS recommendations.

Outlines a step-by-step process applicable across all performance objectives consistent with White Paper.

- Framework is called "Objectives Hierarchy" (OH).
  - OH is a structured set of performance objectives.
- Transparent decisions are based on success criteria.
  - Provides clarity of requirements for acceptance, consistent with the Principles of Good Regulation.
- Consistent decision-making across levels of detail is represented by OH.
  - Logical construct of framework accommodates a wide range of levels of detail.
- Realization of successful outcomes is objectively verified.
  - Achievement of performance objectives validated by current observations.

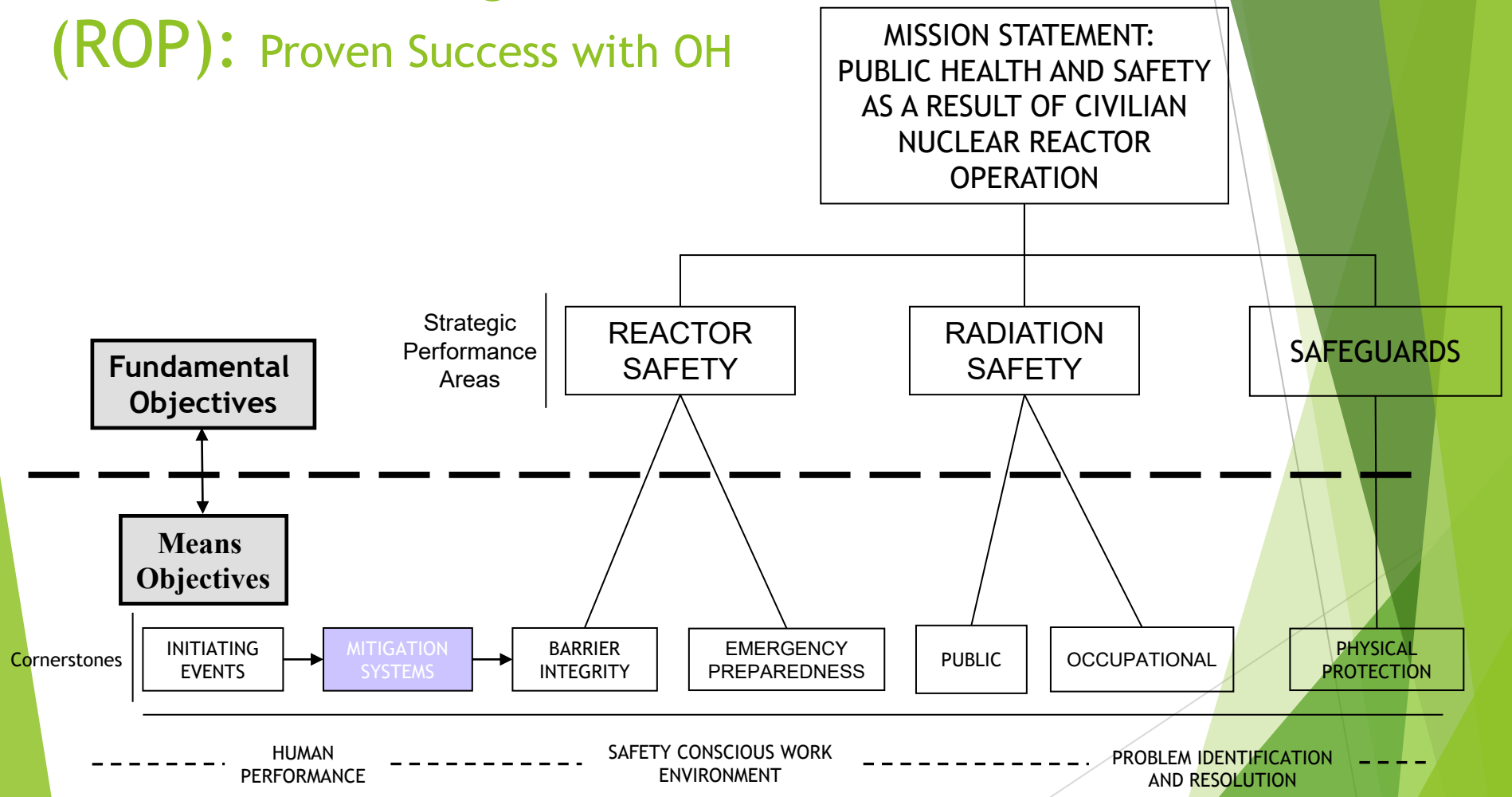
NUREG/BR-0303, "Guidance for PB Regulation" [continued]

OH construct addresses complexity of issue, uncertainty of solutions, multiple competing objectives, and different stakeholder perspectives.

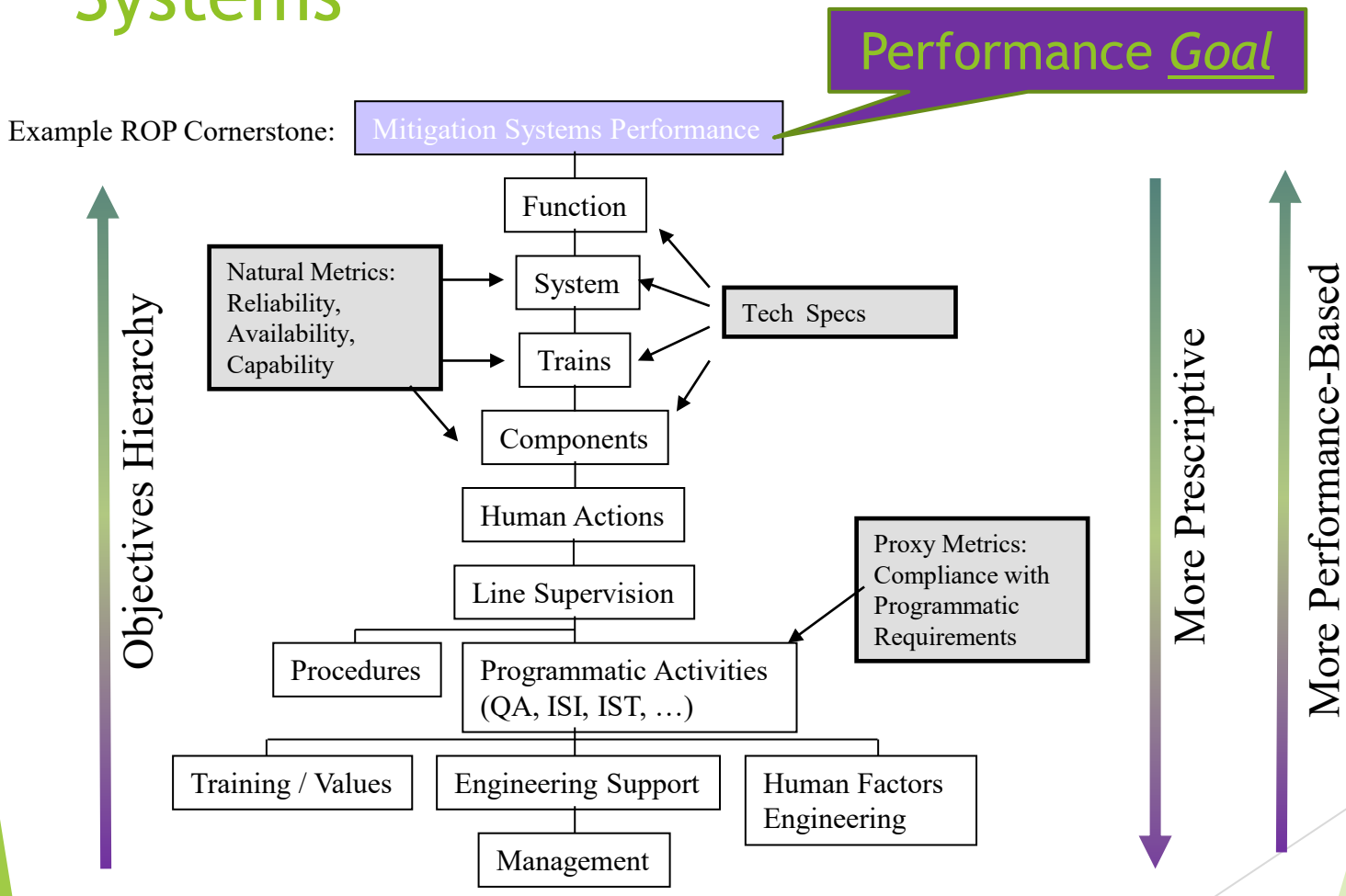
Guidance employs theories of decision analysis to address completeness of consideration of performance factors.

- OH expresses relationships and dependencies involving diverse performance objectives.
  - Enables formal methods to optimize topics such as safety and security, or safety and economics.
- OH enables flexible implementation of acceptance criteria to focus at highest practical level.
  - Enables making connection to things like ITAACs.
- OH enables structuralist defense-in-depth for principles "prevention" and "mitigation."
  - Logic of hierarchy enables "prevention" at lower levels and "mitigation" higher up.

Reactor Oversight Process (ROP): Proven Success with OH



ROP Means OH Mitigation Systems



Checkoff Against Outcome Objectives

- Structured performance objectives
- Acceptance criteria for requirements
- Logical construct for levels of detail
- Verification of outcomes

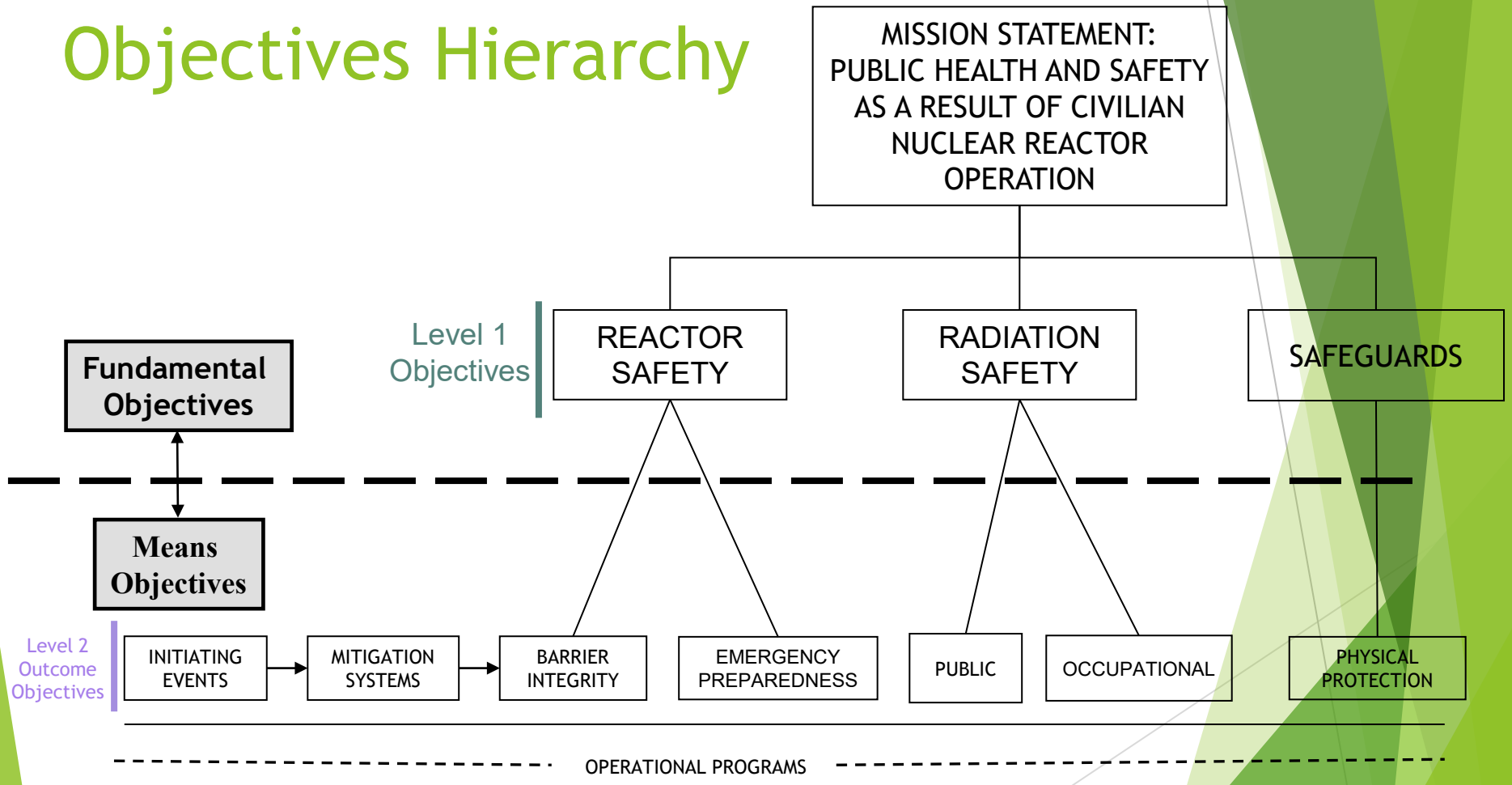
- Fundamental Objectives (FO) of reactor safety, radiation safety and safeguards are structurally related to seven “Cornerstones.”
- Acceptance criteria for requirements associated with FO are provided in regulations.
- Regulations vary in levels of detail and prescriptiveness.
  - Generally, a greater level of detail involves more prescriptiveness.
- Before ROP, verification of outcomes was based on strict regulatory compliance.
- ROP offers flexibility to NRC and licensees to gain benefits of PB approach to managing requirements.

Checkoff Against Outcome Objectives [continued]

- Optimization across diverse topics
- Flexibility from higher level decision-making
- Enabling structuralist defense-in-depth

- Formal consideration of margins with “reactor safety” and “safeguards” can optimize requirements to serve both.
  - Optimization can consider achievable objectives balanced between design and operations.
- Decision-making moves to higher levels if “balance” between objectives is mandated for safety and security.
  - Integrated decision-making described in NUREG-2150 is most suitable for this purpose.
- Guidance in NUREG/BR-0303 calls for achieving higher-level objectives with multiple lower-level objectives.
  - “Mitigating systems” and “barrier integrity” could support “reactor safety” in multiple ways.

10 CFR Part 53 Objectives Hierarchy



Operational Programs

Each applicant must describe operational programs that emphasize and reinforce industry best practices in the following areas:

- quality management
- human performance
- safety conscious work environment
- problem identification and resolution
- radiation management as low as reasonably achievable
- operator training and qualification

Value of RIPB Methods in Part 53

RIPB methods can be applied to avoid unnecessary requirements in Part 53.

- Avoiding unnecessary requirements is an important aspect of reducing costs of nuclear technology.
- An NRC approved decision-making framework should provide a basis for requirements management (RM).
- Adopting and adapting NUREG/BR-0303 for better RM in Part 53 remains the challenge requiring NRC attention.
- Lessons from ROP and "functional containment" issues could point the way to improve RM for Part 53.

How to Apply PB in Subparts B, C, and F of Part 53

- Subpart B identifies safety requirements for applicants.
  - Applicant to show acceptance criteria for safety requirements will be met with margin.
- Acceptance criteria are developed using Subpart C.
- Subpart F can provide the means for managing margins by evidence developed during operations.

- Success for Part 53 requires that applicants see tangible benefits over existing approaches.
- The Commission's vision for PB regulation included an incentive structure not found elsewhere.
- Applicants and licensees will be looking for transparent ways to confidently manage regulatory requirements.
- Subpart B is directed at carrying out safety objectives by meeting safety criteria.
  - Subpart B requirements to which safety criteria are associated should be focused on the apex of the pyramid.
  - Multiple gaps exist between this vision of success and process requirements in Subpart B.

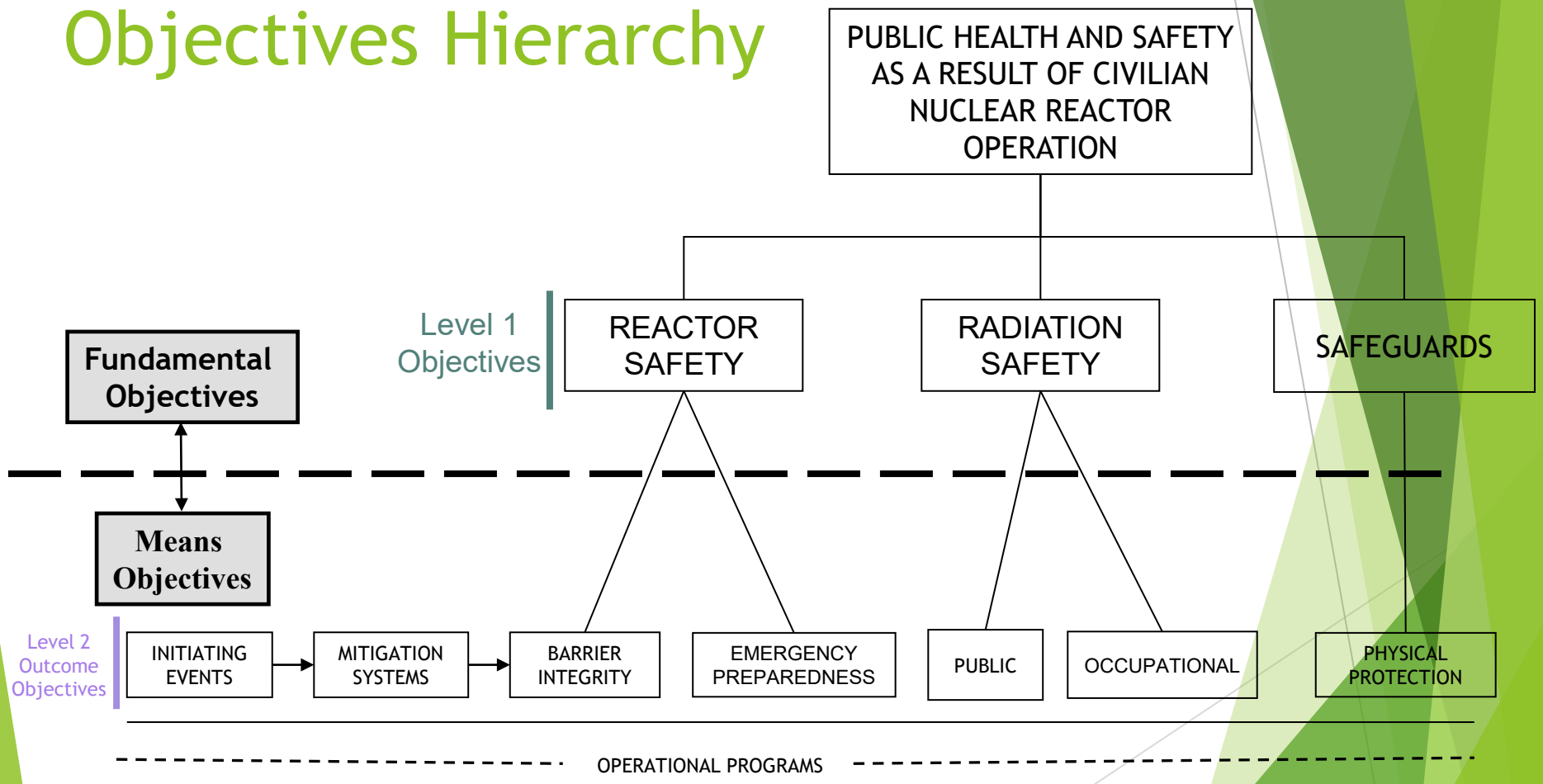
Subpart B: Technology-inclusive Safety Requirements

Proposed Hierarchical Construct for Performance Objectives

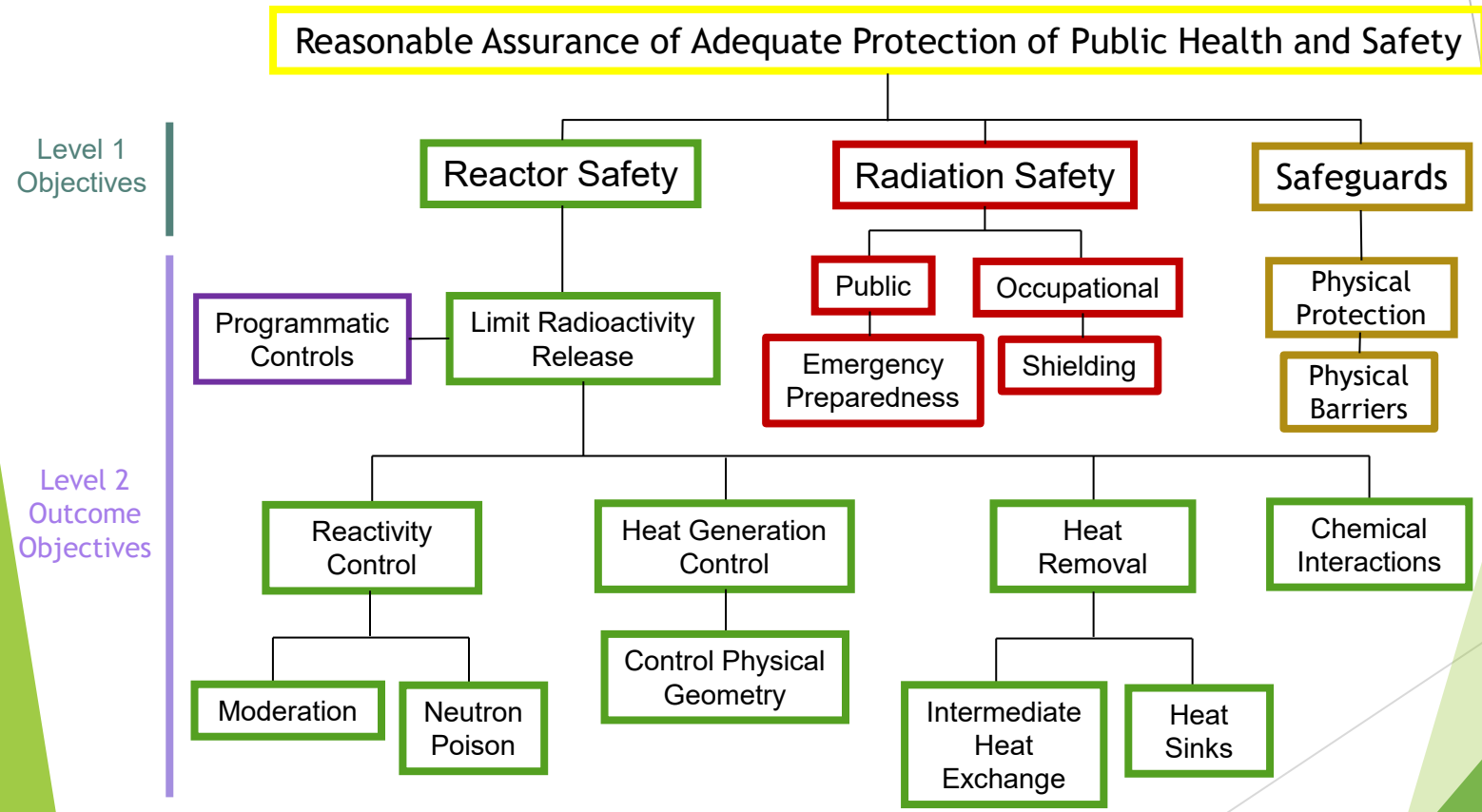
- Applicability of the OH concept from NUREG/BR-0303 is evident in Subpart B.
- Vision of outcomes in White Paper can be realized by achieving success for performance objectives.
- Improved outcomes from better margins management can be shown with real-time observations.
- See backup slide 30.

- The highest-level performance objectives (see §53.220) are associated with design features and programmatic controls.
  - OH representation for each of these performance elements can be developed for more detailed requirements.
- Highest level functional objective from §53.230(a) is to limit radioactivity release.
- Below the highest level, §53.230(b) addresses "Additional safety functions" and offers examples.
  - Appropriately, the examples are not prescriptive; hence, the additional safety functions can be structured to suit any given technology and design.
- LBEs are used to establish (see §53.240) functional requirements further down the hierarchy to the SSC level.

10 CFR Part 53 Objectives Hierarchy



Notional Objectives Hierarchy for Subpart B Using Molten Salt Reactor



Subpart C: Design and Analysis Requirements

Proposed Role to Define Acceptance Criteria for Performance Objectives

- Design of physical features to meet LBE requirements will need to consider human actions and programmatic controls.
- The functional design criteria specified can employ a PB approach to identify analytical margins to support operational flexibilities.
- The license could include incentives for improved outcomes.

- Implementation of NUREG/BR-0303 enables consideration of physical and temporal margins.
- Appropriate use of standards such as those by ASME assures physical margins.
- Practical use of temporal margins may require detailed consideration of LBE transients and operator responses which are part of programmatic controls.
- Under the terms of §53.470, acceptance criteria for performance objectives included in an application can provide the basis for overall margins to be used to improve safety outcomes.
- Incorporating incentives within the license will involve application of Subpart F.

Subpart F: Requirements for Operation

Proposed Role to Incentivize Improved Outcomes Using Evidence of Margins

- Requirements for operation (Subpart F) should recognize continuity between design, analysis, and operation to validate margins and use the PB approach to reward licensees for strengths in maintenance, personnel skills, and recording operational data to improve confidence in margins assessment.
- Reliable margins should enable relaxation of license conditions.

- Current rule language is one-sided toward increasing restrictions on licensed operations.
- A formal PB approach to Subpart F requirements should be allowed to "encourage and reward improved outcomes."
- Provisions in §53.890 include the possibility of such incentivization.
- The regulatory construct should incorporate documentation and verification of margins data to simplify a two-sided, margins-management program.
- The need to seek exemptions should be minimized.

Summary

- A PB approach would be truly transformative because it would result in a framework that promotes logical arguments favoring improved safety outcomes.
- The aspiration to reduce prescription would be based on margins management over a wide range of levels of detail.
- A formal implementation of a PB approach realizes Commission policy to review designs and oversee plant operation in a consistent and coherent manner.
- A PB structure can be realized in Subparts B, C, and F if prescription is removed from these provisions.
- A successful Part 53 will provide flexibility as well as encourage and reward improved safety outcomes.

QUESTIONS & SUGGESTIONS?

Backup Slides with Part 53 Rule Language

Rule Language in Subpart B

Paragraph	Rule Language
§53.200	**Safety Objectives:** …These safety objectives shall be carried out by meeting the safety criteria identified in this subpart
§53.220	**Safety Criteria for LBE…:** Design features and programmatic controls must be provided to
§53.220(a)	Ensure plant SSCs, personnel, and programs provide the necessary capabilities and maintain the necessary reliability to address licensing basis events…
§53.220(b)	Maintain overall cumulative plant risk from licensing basis events…
§53.230(a)	**Safety Functions:** The primary safety function is limiting the release of radioactive materials…
§53.230(b)	Additional safety functions supporting the retention of radioactive materials during licensing basis events—such as controlling reactivity, heat generation, heat removal, and chemical interactions…
§53.240	…The analysis of licensing basis events must be used to confirm the adequacy of design features and programmatic controls needed to satisfy safety criteria defined in §53.210 and §53.220, … and to establish related functional requirements for plant SSCs, personnel, and programs.

Rule Language in Subpart C

Paragraph	Rule Language
§53.470	**Maintaining Analytical Safety Margins Used to Justify Operational Flexibilities:** Where an applicant or licensee so chooses, alternative criteria more restrictive than those defined in §§ 53.220 and 53.450(e) may be adopted to support operational flexibilities. In such cases, applicants and licensees must ensure that the functional design criteria of § 53.420, the analysis requirements of § 53.450(e), and identification of special treatment of SSCs and human actions under § 53.460 reflect and support the use of alternative criteria to obtain additional analytical safety margins. Licensees must ensure that measures taken to provide the analytical margins supporting operational flexibilities are incorporated into design features and programmatic controls and are maintained within programs required in other Subparts

Rule Language in Subpart F

Paragraph	Rule Language
§53.890	**Facility Safety Programs:** Each licensee must establish and implement a facility safety program (FSP) that routinely and systematically evaluates potential hazards; operating experience related to plant SSCs, human actions, and programmatic controls affecting the safety functions required by § 53.230; and the resulting changes in risks to the public from operation of the facility over its operating lifetime. An FSP must include a risk-informed, performance-based process to proactively identify new or revised internal or external hazards to the facility and performance issues related to plant SSCs, human actions, and programmatic controls; assess changes in the risks posed to the public from the licensed commercial nuclear plant; and, when appropriate, must consider measures to mitigate or eliminate the resulting risks using the criteria defined in § 53.895. The FSP must be implemented and supported by a written FSP as required in § 53.900.

RIPB CoP Related Links

- Access the RIPB CoP site on ANS Collaborate at

https://collaborate.ans.org/communities/group-home?CommunityKey=0984f3cf-63e2-4c9a-8538-84c2c97c034d

Then look for the "Join Group"

button to stay informed of CoP

activities and be included in discussions

- Find CoP presentations posted on RP3C's public website at http://www.ans.org/standards/rp3c/

Just scroll down the page to find presentations