



Performance-based Regulation:

Where We Are and
Where we Need to Be



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"Lozheine" 1998
Tatyana Ryzhenko, Ukrainian
Artist, Oil on Canvas, 100x120 cm

Where We Have Been



- Commission Direction re Modernization (1999)
 - Risk-informed (RI) and Performance-based (PB) approaches
 - Terms defined by the Commission in SRM-SECY-98-144
 - RI/PB approach to oversight (Reactor Oversight Process, ROP)
 - Nuclear Energy Innovation and Modernization Act (2019)
 - 10 CFR Part 53
- Focus on RI Reviews using Licensing Modernization Project (LMP 2021)
 - Conflation of terms during NRC public meeting on Framework B (June 16, 2022)
 - NRC public meeting to align on terminology (June 30, 2022)
 - NRC public meeting to discuss NEIMA concepts and confirm alignment on terminology (July 28, 2022)



Technology Inclusive and Risk-Informed Reviews for Advanced Reactors:
Comparing the US Licensing Modernization Project with the Canadian Regulatory Approach



More Recent Developments



- 10 CFR Part 53 Submitted to Commission (March 2023)
- Commission Directed Staff to Revise Rule (March 2024)
- Continued Lack of Coherence Around PB Methods
 - NRC's Regulatory Information Conference (RIC), March 2024
 - Question about whether NRC really is performance-based and risk-informed
 - Responses focused almost exclusively on RI concepts, not PB methods
 - Advanced Reactor Stakeholder Meetings (March 27 and May 23, 2024)
 - More focus on RI and LMP
 - Stakeholder requests for further discussion of PB approaches
 - Advanced Reactor Construction Oversight Process Workshops (Feb-Jul, 2024)
 - Focus on enforcement of compliance, not performance
 - Not pursuing performance indicators because data do not exist
- Passage of the Accelerating Deployment of Versatile Advanced Nuclear for Clean Energy Act of 2024 (ADVANCE Act, July 9, 2024)

Where We Are



- July 18, 2024 – NRC Risk Metrics Workshop
 - Stakeholders (particularly small reactor developers) struggle with implementing LMP
 - DOE Lab contrasted “margin-based” and “probability-based” assessment of structure, system and component (SSC) performance
 - “Probability-based” assessment of SSC monitoring system and decision process based on plant CDF and LERF
 - “Margin-based” assessment of SSC health based on monitoring performance data
- Margin-based Performance Monitoring Represents a PB Approach
 - Provides for assessment of SSC health during reactor demonstration
 - Facilitates seamless transition to continuous performance monitoring of data during commercial operation
 - Affords efficient, effective regulatory oversight of RI safety parameters using performance indicators



Where We Need to Be

More Attention to PB Solutions

- Observable parameters (quantitative, qualitative, or combination) directly related to outcomes are developed
 - Margin-based approaches to SSC performance (use demonstration data for FOAK and operational data for oversight and performance monitoring)
- Objective acceptance criteria for each parameter is developed.
 - Margin-based approaches to SSC performance (compare actual performance to objective performance criteria)
- A decision-making framework is developed for evaluating and assessing physical and temporal margins.
 - Structured hierarchy with high-level performance objectives
- Flexibility is afforded to the licensee to show that the margins are being employed to improve outcomes.
 - Prescription is minimized in regulations, guidance and industry standards
 - Applicants propose means for demonstrating how high-level performance objectives are met





Advantages of PB Approaches



- Achieve high levels of safety performance without undue regulatory burden
- Key to satisfying NEIMA mandate for technology-inclusive frameworks
 - Offer flexibility for innovation
 - High-level performance objectives are technology-neutral
 - Incorporate risk insights
- Data-driven vice theoretical
 - Utilize actual reactor demonstration and operational data
 - Offer seamless transition to PB oversight during plant operation
 - Save time and costs to license first-of-a-kind reactors (FOAK)
 - Support rapid deployment of n^{th} -of-a-kind reactors (NOAK)
- Can leverage advances in digital technology for continuous monitoring
 - Facilitate international harmonization

Summary, Conclusion & Next Steps



Summary:

Most stakeholders agree that regulatory modernization is necessary to keep pace with innovation, incentivize improved safety outcomes, and mitigate enterprise risk to the industry.

Conclusion:

It is not clear how NRC and stakeholders define “modernization,” particularly as it pertains to PB approaches.

Next Steps:

A workshop is needed to establish a shared understanding of what PB means and how it will be applied to satisfy 1999 Commission direction, NEIMA, and the ADVANCE Act.