What Society Needs in 10 CFR Part 53

Rani Franovich, Senior Policy Advisor
Nuclear Energy Innovation

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The Breakthrough Institute

- Independent research center
- Identifies and promotes technological solutions to environmental and human development challenges
- Represents public interests
- Does not receive funding from industry
Report Overview

- Technology-neutral study that chooses optimal technologies for least cost
  - Utilizes a high-resolution nationwide model of the United States (WIS:dom-P)

- Investigates the bounds of the potential role of advanced nuclear energy in a future U.S. clean energy system

- Evaluates the potential impact through
  - Deployment
  - Investment and opportunities
  - Barriers
  - Supporting policies
  - Economics and employment
  - Fossil to nuclear energy transition potential

- Contributes to literature on methods and best practices for modeling advanced nuclear energy
Realizing a Technology-Inclusive Rule

A technology-inclusive rule is defined in the Nuclear Energy Innovation and Modernization Act (NEIMA) of 2019 as a regulatory framework developed using methods of evaluation that are flexible and practicable for application to a variety of reactor technologies, including, where appropriate, the use of risk-informed and performance-based techniques and other tools and methods.
Part 53 is necessary to improve the general public welfare by enabling both innovation and commercialization of advanced nuclear reactors.

It remains unclear how either Framework A or Framework B conforms with NEIMA or meets the needs of Society.

NRC is crafting rule language and frameworks that could constrain development of emerging technologies vital to climate change mitigation, energy security and other pressing concerns in Society.

A 1000-page proposed rule package that industry will not use will not be responsive to NEIMA.

Part 53 should establish high-level safety goals and allow greater flexibility for a wide range of diverse and emerging technologies.

Frameworks A and B could represent acceptable methods and should be relocated to guidance documents, which offer both clarity and flexibility.
Some amount of prescription is necessary in regulatory requirements.

Risk is defined as a situation involving exposure to danger.

Objectives Hierarchy: A performance-based regulation identifies safety objectives at a high level.

Probabilistic risk analysis (PRA) is one way to risk-inform a regulation, but not the only way.
Typical Requirements Management Structure

Level 1 Objectives
- Mission Statement
- Customer Requirements

Level 2 Outcome Objectives
- System Technical Requirements
- Detailed Technical Requirements
- Derived Requirements

Mission Analysis
Requirements Analysis
Functional Analysis
Subsequent Iterations

Part 53 Requirements Management Structure

Level 1 Objectives
Level 2 Outcome Objectives
(§ 53.200 series)
Reactor Oversight Process (ROP)
Proven Success with Objectives Hierarchy

MISSION STATEMENT:
PUBLIC HEALTH AND SAFETY AS A RESULT OF CIVILIAN NUCLEAR REACTOR OPERATION

Level 1 Objectives

Fundamental Objectives

Level 2 Outcome Objectives

Means Objectives

Cornerstones

 INITIATING EVENTS  MITIGATION SYSTEMS  BARRIER INTEGRITY  EMERGENCY PREPAREDNESS  PUBLIC  OCCUPATIONAL  PHYSICAL PROTECTION

HUMAN PERFORMANCE  SAFETY CONSCIOUS WORK ENVIRONMENT  PROBLEM IDENTIFICATION AND RESOLUTION
Means Objectives Hierarchy
Example ROP Cornerstone

Level 2 Objective

Mitigation Systems Performance

- Function
- System
- Trains
- Components
- Human Actions
- Line Supervision

Natural Metrics: Reliability, Availability, Capability

Proxy Metrics: Compliance with Programmatic Requirements

Performance Goal

- Procedural Activities (QA, ISI, IST, …)
- Training / Values
- Engineering Support
- Human Factors Engineering
- Management

More Prescriptive

- Tech Specs

More Performance-Based

- Engineering Support
- Human Factors Engineering
- Management

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Oversight Decision
Reactor Oversight Process (ROP)
Proven Success with
Objectives Hierarchy

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PUBLIC HEALTH AND SAFETY
AS A RESULT OF CIVILIAN
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Level 1
Objectives

Fundamental Objectives

Level 2
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Means Objectives

Cornerstones

INITIATING EVENTS
MITIGATION SYSTEMS
BARRIER INTEGRITY
EMERGENCY PREPAREDNESS
PUBLIC
OCCUPATIONAL
PHYSICAL PROTECTION

HUMAN PERFORMANCE
SAFETY CONSCIOUS WORK ENVIRONMENT
PROBLEM IDENTIFICATION AND RESOLUTION
10 CFR Part 53
Objectives Hierarchy

MISSION STATEMENT:
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OPERATIONAL PROGRAMS
Operational Programs

Each applicant must describe operational programs that emphasize and reinforce industry best practices, for example 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
Closing Thoughts

- A technology-inclusive, risk-informed and performance-based approach licensing pathway should minimize the need for exemptions from regulatory requirements.
- The preliminary rule can be simplified by
  - retaining high-level performance goals; and
  - relocating prescriptive, deterministic criteria for how those goals can be accomplished to guidance.
- For Part 53 to be successful, it must be durable as new and advanced reactor technologies are developed in the decades to come.