ANPR on Risk-Informed and Performance-Based Revision to 10 CFR Part 50

Public Workshop

September 14-15, 2006

Mariott Pooks Hill,
Bethesda, MD

Workshop Agenda Day 1

Time	Topic
8:00 am to 8:30 am	Introduction – • Workshop Structure • Opening Remarks • Purpose • Background
8:30am to 10:00 am	Staff Presentations -- ANPR
10:00 am to 10:30 am	break
10:30 am to 11:30 am	Staff Presentations – ANPR/Framework
11:30 am to 1:00 pm	Lunch
1:00 pm to 3:00 pm	Stakeholder presentations
3:00 pm to 3:30 pm	Break
3:30 pm to 4:30 pm	Open Dialogue: ANPR topics – • Plan • Continue with Part 50
4:30 pm to 5:00 pm	Discuss sessions organization
5:00 pm	Adjourn

Workshop Agenda Day 2

Time	Breakout sessions				
8:00 am to 10:00 am	Session 1	Session 2	Session 3	Session 4	Session 5
10:00 am to 10:30 am	break				
Time	Breakout sessions				
10:30 am to 12:30 pm	Session 6	Session 7	Session 8	Session 9	Session 10
12:30 pm to 2:00 pm	Lunch				
2:00 pm to 3:30 pm	Wrap-up and Summary •Presentation by each Session Chair				
3:30 pm	Adjourn				

WORKSHOP STRUCTURE

- Questions and comments during Open Discussion and Breakout Sessions only
- Individuals are to state their name and affiliation
- Workshop is NOT being transcribed
  - Workshop discussion will be summarized and posted
- Workshop agenda times may be adjusted to match questions, comments and discussions
- Public Meeting Feedback form, please complete and turn in (or mail)
- Registration form, please complete and turn in
- Category 3 meeting

Breakout Sessions

- Sessions 1/6: ANPR Topics —
  - I. Single Failure Criterion (Questions 60-63)
  - G. Framework: Probabilistic Design Criteria (Questions 42-47)
- Session 2/7: ANPR Topics —
  - G. Framework: Development and Implementation (Questions 31-34, 50-54)
- Session 3/8: ANPR Topics —
  - C. Level of Safety (Questions 13-20)
  - D. Integrated Risk (Questions 21-23)
  - E. ACRS Views (Question 24)
- Session 4/9: ANPR Topics —
  - F. Containment Function Performance Standards (Questions 25-30)
  - G. Framework: Defense-in-Depth (Questions 35-41)
  - H. Defense-in-Depth (Questions 55-59)
- Session 5: ANPR Topics —
  - B. Integrations of Safety, Security and Emergency Preparedness (Questions 8-12)
  - G. Framework: Security Performance Standards
- Session 10: ANPR Topics —
  - G. Framework: PRA Technical Acceptability (Questions 48-49)

Opening Remarks

PURPOSE OF WORKSHOP

- Discuss the ANPR topics with stakeholders
- Gain early insight into possible stakeholder input prior to the closing of the ANPR - December 29, 2006

Background

- The Commission directed the staff to
  - Develop a formal program plan to make a risk-informed and performance-based revision to 10 CFR Part 50
  - Develop in an expeditious fashion an ANPR to consider the spectrum of issues relating to risk-informing the reactor regulations
  - Incorporate in the ANPR a formal program plan for risk-informing 10 CFR Part 50, as well as other related risk-informed efforts
  - Integrate safety, security, and preparedness
  - Include the effort to develop risk-informed and performance-based alternatives to the single failure criterion

Background (cont'd)

- The Commission directed the staff to
  - Issue the ANPR
  - Complete the ANPR stage by December 2006
  - Provide its recommendation on whether and, if so, how to proceed with rulemaking by May 2007 having considered ACRS views
  - Provide, with its recommendation, a detailed summary of any differing stakeholder views to ensure that the Commission has the benefit of these views when deliberating on the staff's recommendation
  - Include a proposed schedule to complete the effort

Background (cont'd)

- ANPR published May 4, 2006, Federal Register, Vol. 71, No. 86, page 26267
- The ANPR referenced "Framework" which is on the NRC ruleforum website
  - Working draft of Framework placed on website April 27, 2006
  - Completed working draft of Framework (NUREG-1860) placed on website August 1, 2006
- ANPR closes December 29, 2006

Background (cont'd)

- Submit comments
  - Mail: Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, ATTN: Rulemakings and Adjudications Staff.
  - E-mail: SECY@nrc.gov.
  - NRC's rulemaking web site: http://ruleforum.llnl.gov.
    - Address questions about our rulemaking web site to Carol Gallagher (301) 415-5905; email cag@nrc.gov.
  - Federal eRulemaking Portal: http://www.regulations.gov.
  - Hand deliver: 11555 Rockville Pike, Rockville, Maryland 20852, between 7:30 am and 4:15 pm Federal workdays. (Telephone (301) 415-1966).
  - Fax: Secretary, U.S. Nuclear Regulatory Commission at (301) 415-1101
- Include RIN 3150-AH81 in subject line

ANPR

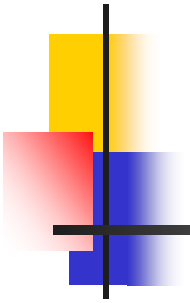
- The NRC's proposed approach is to create a new Part in 10 CFR (referred to as "10 CFR Part 53")
  - Integrated risk-informed and performance-based alternative
  - Safety, security and preparedness integrated to provide a cohesive structure

ANPR

- Objectives of new Part 53:
  - Enhance safety and security by focusing NRC and licensee resources in areas commensurate with their importance to public health and safety,
  - Provide NRC with a framework that uses risk information in an integrated manner,
  - Use risk information to provide flexibility in plant design and operation while maintaining or enhancing safety and security,
  - Ensure that risk-informed activities are coherently and properly integrated such that they complement one another and continue to meet the 1995 Commission's PRA Policy Statement,
  - Allow for different reactor technologies in a manner that will promote stability and predictability in the long term.

ANPR

- NRC would undertake two major tasks:
  - Develop the technical basis for rulemaking for 10 CFR Part 53, and
  - Develop the regulations and associated guidance for 10 CFR Part 53.



ANPR

- NRC plans to continue the current risk-informed rulemaking actions (e.g., 10 CFR 50.61, 10 CFR 50.46) that are ongoing
- NRC would undertake new risk-informed rulemakings on an as-needed basis

ANPR

- Policy and technical issues associated with development of a new Part 53
- Input solicited in ANPR on these issues:
  - Integration of safety, security, and preparedness
  - Level of safety
  - Integrated risk
  - ACRS views
  - Containment functional performance standards
  - Defense-in-depth
  - Single failure criterion

ANPR – Integration of Safety, Security, Preparedness

- The Commission believes that safety, security, and emergency preparedness should be integrated in developing a risk-informed and performance-based set of requirements for nuclear power reactors (i.e., in this context, 10 CFR Part 53)
- The NRC has proposed to establish security performance standards for new reactors
- Under the proposed approach, nuclear plant designers would analyze and establish, at an earlier stage of design, security design aspects such that there would be a more robust and effective (intrinsic) security posture and less reliance on operational (extrinsic) security programs (guns, guards and gates)
- This approach takes advantage of making plants more secure by design rather than security components being added on after design

ANPR – Level of Safety

- The staff, in SECY-05-0130, proposed options for establishing a regulatory standard that would be applied during licensing to enhance safety for new plants consistent with the Commission's policy statement for Regulation of Advanced Nuclear Power Plants.
- Four options were evaluated which included:
  - Perform a case-by-case review,
  - Use the Quantitative Health Objectives (QHOs) in the Commission's policy statement on ``Safety Goals for the Operation of Nuclear Power Plants''
  - Develop other risk objectives for the acceptable level of safety, and
  - Develop new QHOs.
- Subsidiary risk objectives could also be developed to implement the Commission's expectation regarding enhanced safety for new plants.
- Such subsidiary risk objectives could be a useful way to:
  - Focus more on plant design,
  - Provide quantitative criteria for accident prevention and mitigation, and
  - Provide high level goals to assist in establishing plant system and equipment reliability and availability targets.
- Currently, subsidiary risk objectives of 10-5/plant year and 10-6/plant year that could be applicable to all reactor designs are being considered for accident prevention and accident mitigation, respectively, where:
  - Accident prevention refers to preventing major fuel damage, and
  - Accident mitigation refers to preventing releases of radioactive material offsite such that no early fatalities occur (i.e., from acute radiation doses).

ANPR – Integrated Risk

- For new plant licensing, potential applicants have indicated interest in locating new plants at existing sites
- The staff, in SECY-05-0130, evaluated three options which included:
  - No consideration of integrated risk,
  - Quantification of integrated risk at the site only from new reactors (i.e., the integrated risk would not consider existing reactors), and
  - Quantification of integrated site risk for all reactors (new and existing) at that site.
- Another aspect of this issue is the level of safety associated with the integrated risk
- The NRC is presently considering whether the integrated risk should be restricted to the same level that would be applied to a single reactor
- If this approach were adopted, for an entity who proposed to add multiple reactors to an existing site, the integrated risk would not be allowed to exceed the level of safety expressed by the QHOs in the Commission's Safety Goal Policy Statement.

ACRS Views on Level of Safety and Integrated Risk

- ACRS concluded that use of the existing QHOs is not sufficient to resolve either of the issues
- ACRS, in considering the overall scope of the issues, found it more apt and effective to reframe the two issues into seven different questions
- Different views are provided on the questions
  - An ACRS position is not provided
- Additional comments are provided by other members
  - "…disagree with our colleagues on the matter of this letter"

ANPR – Containment Standards

- The Commission has directed the staff to develop options for containment functional performance requirements and criteria which take into account such features as core, fuel, and cooling system design.

ANPR -- Framework

- In support of determining the requirements for these alternative regulations, the NRC is developing a risk-informed, performance-based framework that could apply to any reactor technology
- This framework provides one approach in the form of criteria and guidelines that could serve as the technical basis for 10 CFR Part 53 that is technology-neutral, risk-informed, and performance-based
- The framework provides the criteria and guidelines for the following: Safety, security, and emergency preparedness expectations. Defense-in-depth and treatment of uncertainties. Licensing basis events (LBEs) identification and selection. Safety classification of structures, systems, and components. PRA technical acceptability

ANPR – Framework (cont'd)

- The Commission believes that safety, security, and emergency preparedness should be integrated.
  - The approach in the framework to achieve this integration is to define the safety, security, and preparedness expectations that are needed and to define protective strategies and defense-in-depth principles for each area in an integrated manner.
- The core of the NRC's safety philosophy has always been the concept of defense-in-depth, and defense-in-depth remains basic to the safety, security, and preparedness expectations of the technology-neutral framework.
  - Defense-in-depth is the mechanism used to compensate for uncertainty. This includes uncertainty in the type and magnitude of challenges to safety, as well as in the measures taken to assure safety.
- In the framework, risk information is used in two basic parts of the licensing process:
  - Identification and selection of those events that are used in the design to establish the licensing basis
  - Safety classification of selected systems, structures, and components.

ANPR – Framework (cont'd)

- The approach proposed in the framework requires a full-scope "living" PRA
- Incorporates operating experience and performance-based requirements in the periodic re-examination of
  - events designated as LBEs that were originally selected based on the design
  - structures, systems, and components that were characterized as safety-significant.
- Framework process identifies the topics which the requirements must address to ensure the success of the protective strategies and administrative controls.
- Process is based upon:
  - Developing and applying a logic diagram for each protective strategy to identify the pathways that can lead to failure of the strategy
  - Through a series of questions, identifying what needs to be done to prevent the failure
  - Applying the defense-in-depth principles to each protective strategy
  - Developing and applying a logic diagram to identify the needed administrative controls
  - Providing guidance on how to write the requirements.

ANPR – Defense-in-Depth

- In SECY-03-0047, the staff recommended that the Commission approve the development of a policy statement or description on defense-in-depth for nuclear power plants to describe:
  - The objectives of defense-in-depth (philosophy);
  - the scope of defense-in-depth (design, operation, etc.); and
  - the elements of defense-in-depth (high level principles and guidelines).
- The policy statement or description would be technology-neutral and risk-informed and would be useful in providing consistency in other regulatory programs (e.g., Regulatory Analysis Guidelines)
- The Commission directed the staff to consider whether it can accomplish the same goals in a more efficient and effective manner by updating the PRA Policy Statement

ANPR – Single Failure Criterion

- In SECY-05-0138, the staff forwarded to the Commission a draft report entitled "Technical Report to Support Evaluation of a Broader Change to the Single Failure Criterion"
- Staff recommended to the Commission that any followup activities to risk- inform the Single Failure Criterion (SFC) should be included in the activities to risk-inform the requirements of 10 CFR Part 50.
- The Commission directed the staff to seek additional stakeholder involvement.
- The report provides the following options:
  - Maintain the SFC as is
  - Risk-inform the SFC for design bases analyses
  - Risk-inform SFC based on safety significance
  - Replace SFC with risk and safety function reliability guidelines.

Framework Overview

Framework – July 2006

- Conceptual approach unchanged since March 2005
- Presentation of information re-organized to better communicate the approach
- Details for the technical issues have been expanded
- Additional information has been included
- Working draft published in April 2006
- Complete working draft published August 1, 2006

Framework

- Provide an overview of the entire Framework document, draft NUREG-1860
- Focus on the additions to the August 1, 2006 version compared to the April 2006 version

Objectives

- The objective of this document is to develop a framework that provides the technical basis, including guidance and criteria, for writing risk-informed, performance-based requirements for licensing future reactors
- These requirements, that may be technology-neutral or technology-specific, will provide for protection of the public health and safety

Scope

- Addresses risks from all sources of radioactivity that are present at the plant except for spent fuel storage and handling
- Addresses risk with reactor full-power, low-power and shut-down operation, and the risks from both internal and external events
- Issues related to security are also considered
- Covers design, construction, and operation
- Operation includes both normal operation as well as off-normal events, ranging from anticipated occurrences to rare but credible events

Relationship to CFR

Cross-Cutting Regulations

10 CFR 1-16
- Legal + Admin

10 CFR 19
- Insp + Investigation

10 CFR 20
- Radiation Protection

10 CFR 21
- Reporting of Defects

10 CFR 25
- Access Authorization

10 CFR 26
- Fitness for Duty

10 CFR 51
- Environ Protection

10 CFR 61
- LLW Disposal

10 CFR 73
- Physical Protection

10 CFR 74
- Material Contrl and Accounting

10 CFR 75
- Safeguards - IAEA

10 CFR 95
- Safeguarding Restricted Data

10 CFR 110
- Export/Import

10 CFR 140
- Financial Protection

10 CFR 171
- Annual Fees

Reactor Fuel Cycle Regulations

Fuel Production

- 10 CFR 40	-	U Mining
- 10 CFR 70	-	U Conversion
- 10 CFR 70/76	-	U Enrichment
- 10 CFR 70	-	Fuel Fabrication
- 10 CFR 71	-	Pkg + Transport

Reactor Licensing

- 10 CFR 50 - Reactor Licensing

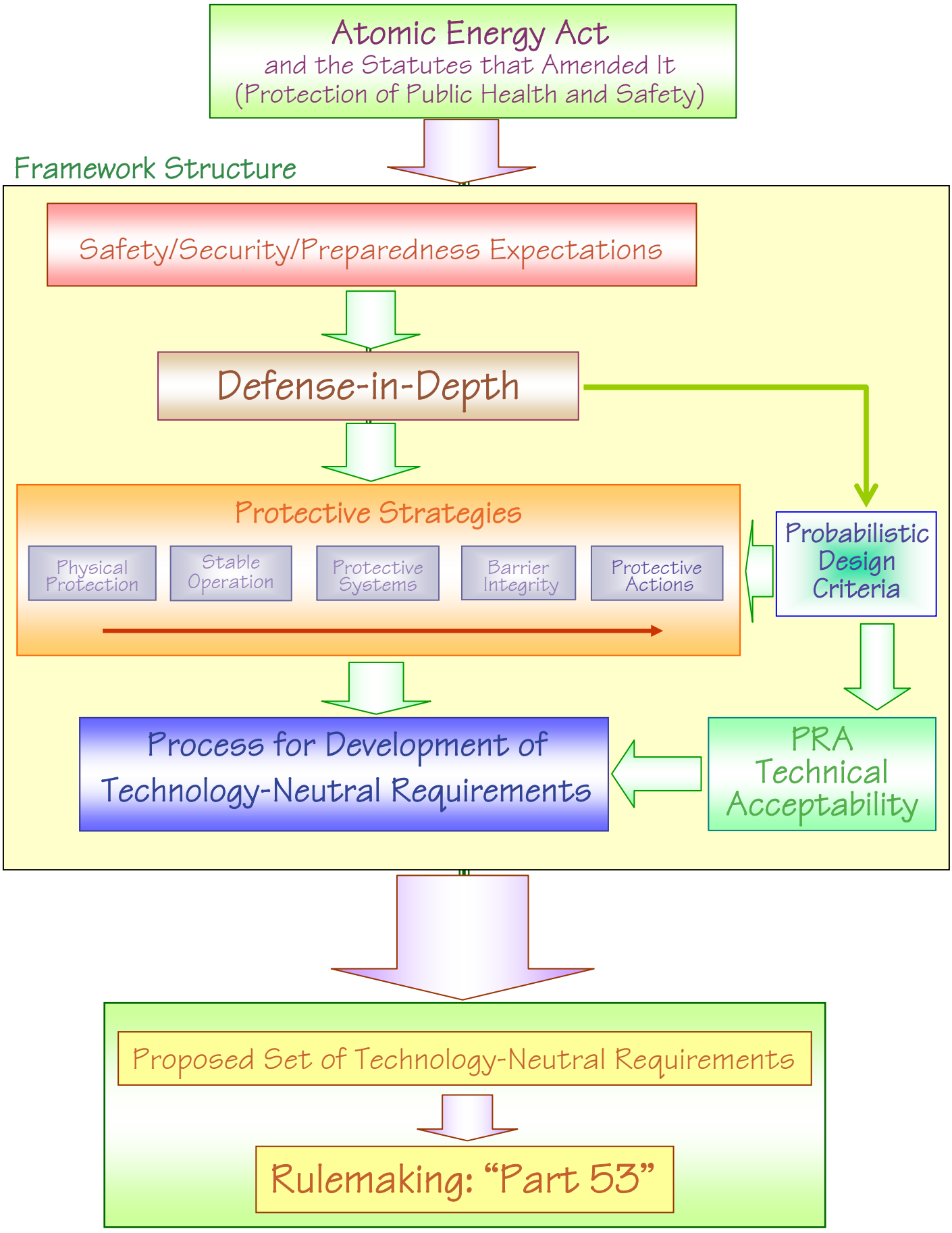
- 10 CFR 52	-	ESPs, Certif, COLs
- 10 CFR 54	-	License Renewal
- 10 CFR 55	-	Operators Licenses
- 10 CFR 100	-	Reactor Siting

Spent Fuel Disposal

- 10 CFR 60	-	HLW Disposal
- 10 CFR 63	-	HLW-Yucca Mountain
- 10 CFR 71	-	Pkg + Transport
- 10 CFR 72	-	Indep Spent Fuel Storage

Framework Elements

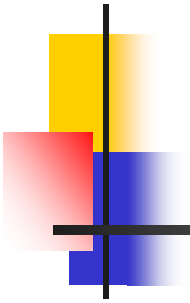
- Safety, security and preparedness expectations
- Defense-in-depth: treatment of uncertainties
- Safety fundamentals
- Design criteria and guidance
- PRA technical acceptability
- Process for the identification of requirements


Atomic Energy Act
and the Statutes that Amended It
(Protection of Public Health and Safety)
Framework Structure
Safety/Security/Preparedness Expectations
Defense-in-Depth
Protective Strategies
Physical Protection
Stable Operation
Protective Systems
Barrier Integrity
Protective Actions
Probabilistic Design Criteria
Process for Development of Technology-Neutral Requirements
PRA Technical Acceptability
Proposed Set of Technology-Neutral Requirements
Rulemaking: "Part 53"

Framework Update

Defense-in-depth Framework Definition

- *Defense-in-depth is an element of NRC's safety philosophy that is used to address uncertainty by employing successive measures including safety margins to prevent and mitigate damage if a malfunction, accident or naturally caused event occurs at a nuclear facility.*



Implementation of Defense-in-Depth

- Process for implementing defense-in-depth into the technical requirements clarified
- Process discussed in Chapter 8

Defense-in-Depth and Safety Margins

Conceptual Definition --

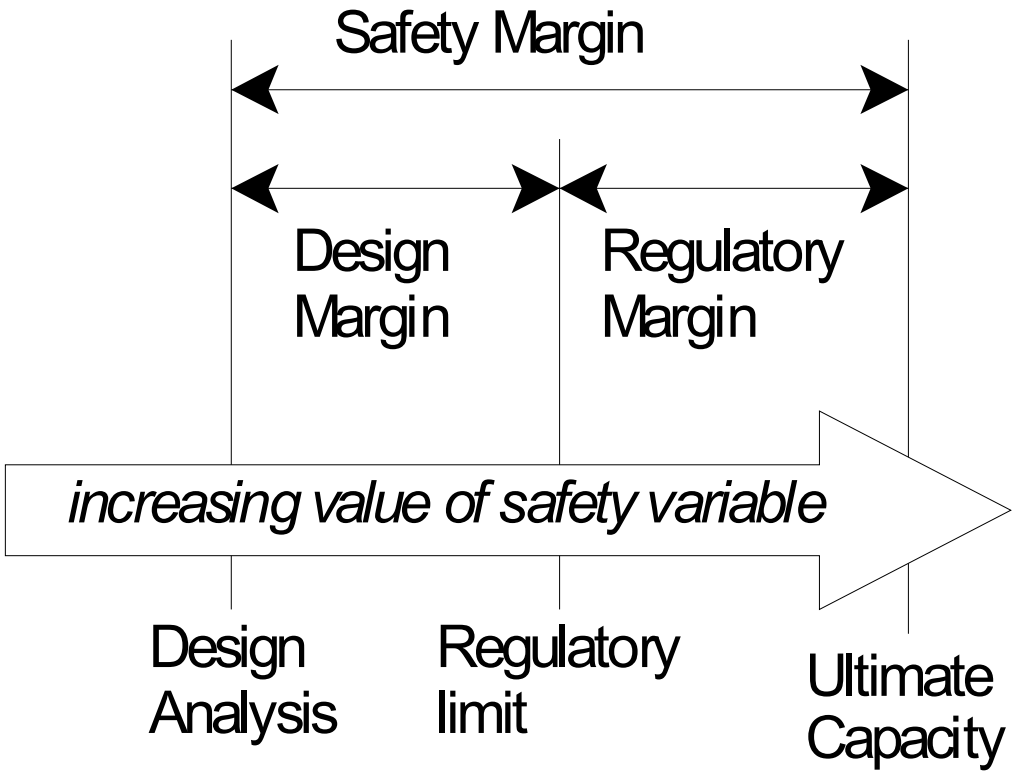


Figure 4-4 Safey Margin Definition

Safety Margin

Specific Definitions --

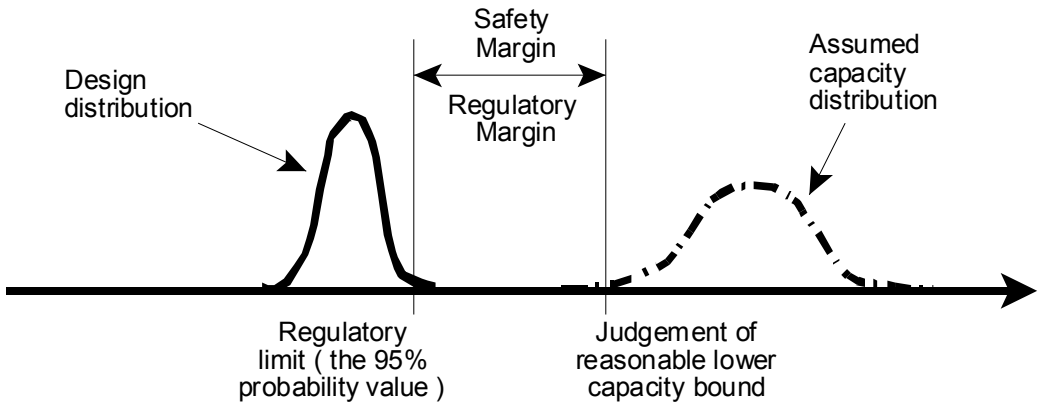


Figure 6-5 Safety Margin

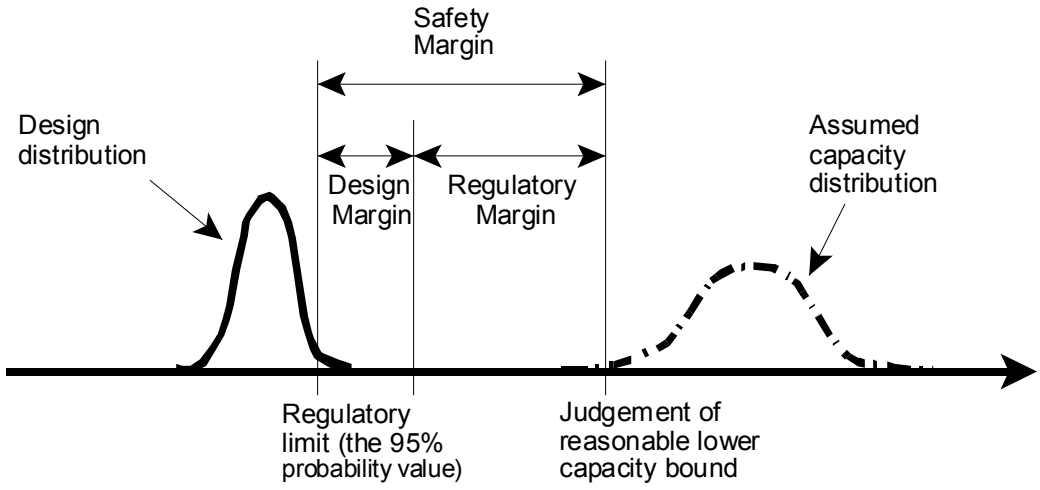


Figure 6-6 Safety Margin with Design Margin

Licensing Basis Event

- Revised process on LBE selection to reflect lessons learned from test case
- Revised the deterministic acceptance criteria for LBEs to address defense-in-depth principles

Test Case – LBE & Safety Classification

- Objective:
  - To test the safety significant SSCs selection process
  - To test the risk-informed LBEs selection process
- Test Case:
  - Used a modified Level2/LERF SPAR model for a currently licensed PWR
- Results:
  - Comprehensive list of safety-significant SSCs
  - 34 LBEs
    - Frequent Events: 4
    - Infrequent Events: 10
    - Rare Events: 20
- What We Learned:
  - The level of safety achieved by the framework selection process and associated acceptance criteria appears to be commensurate with that required for current plants

Security Performance Standards

- Define quantitative and qualitative criteria that can be used to determine whether or not the security expectations discussed above are met
- A risk-informed and performance-based approach has been taken in the development of security performance standards
  - Utilizes a combination of risk criteria to define the level of safety desired and deterministic criteria to complement the risk criteria to help account for uncertainties
  - An integrated decision process is then used to assess the various elements of the standards and the need for any additional action

Security Performance Standards

- Probabilistic Performance Standard:
  - Assess and take action on vulnerabilities in accordance with Figure 1
- Deterministic Performance Standards:
  - Ensure that the plant design, operation and security for each security related threat that could endanger public health and safety provide
    - multiple lines of defense
    - both prevention and mitigation measures
- Theft or Diversion Performance Standards:
  - For plant designs using MOX or HEU fuel, ensure that detection and surveillance are provided sufficient to detect the theft or diversion of material that could result in an Extraordinary Nuclear Occurrence, as defined in 10 CFR 140
- Design Solution Performance Standard:
  - The resolution of security related issues should utilize design solutions, whatever practical

Integrated Decision-Making

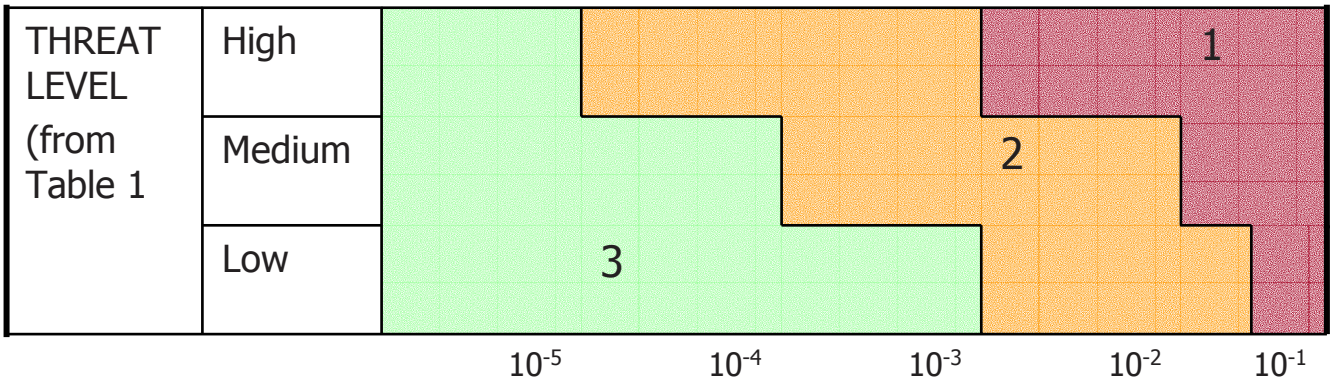
- Other factors not related to performance standards need to be considered in the decision:
  - The requirements in 10 CFR 73 and the post 9/11 orders should be complied with, unless an exemption is obtained
  - The scope and quality of the analysis used in the assessment should be consistent with the scope of the threat being assessed and with accepted methods and data
  - The impact of security related actions (e.g., design changes, operational changes) should not detract from overall plant safety or preparedness or worker safety
  - Unquantified uncertainties should be considered with respect to whether or not they could have a major influence on the decision

Threat Level Severity

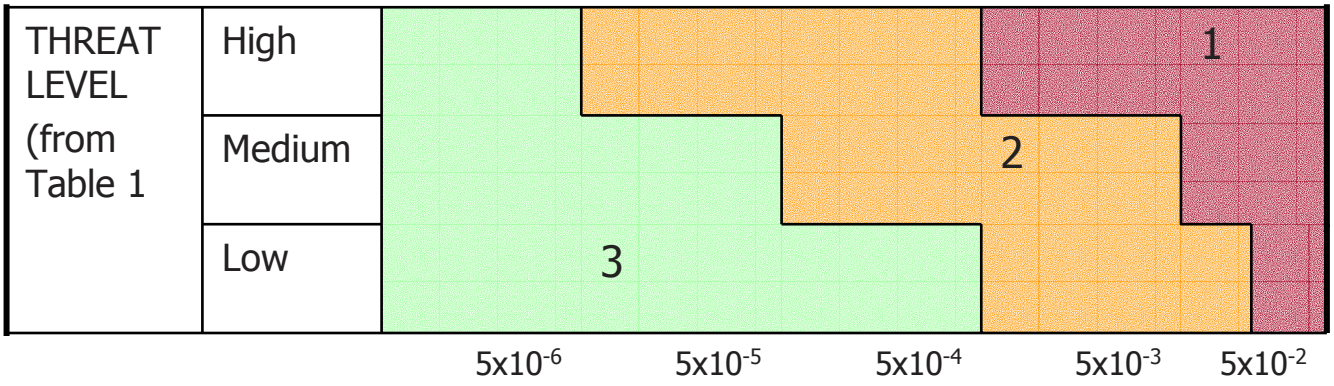
Level	Description
High	Capability exists, intentions stated and history make this a credible threat.
Medium	Capability and history exist, but no stated intentions make this a possible threat.
Low	Capability exists, but no stated intentions or history make this an unlikely threat.
Negligible	Neither capability, intentions or history exists and the threat is not considered credible.

CONDITIONAL INDIVIDUAL RISK (mean value)

Latent Fatalities



Early Fatalities



1 = action warranted, regardless of cost
2 = cost-benefit region
3 = no action warranted

Process

1. For each protective strategy, a logic tree is developed that identifies what would need to occur to fail the protective strategy
2. For each protective strategy logic tree, for the end points of each branch, the root cause of failure (in the form of a question) is identified
3. Topics are identified that need to be addressed in answering each question; this include incorporation of
    1. Defense-in-depth considerations
    2. Risk and design criteria
    3. Topics are categorized as whether they are design, construction, operation related
4. Requirements are developed based upon the topics identified
    1. Lessons learned from past considered
    2. 10 CFR Part 50 requirements used where practical
    3. Risk-informed and performance-based guidance
5. Completeness check is performed
6. Identify which of the requirements will require some technology-specific guidance

Appendices

A. Safety Characteristics of the New Advanced Reactors
B. Relationship TO 10 CFR
C. Protection of the Environment
D. Derivation of Risk Surrogates for LWRS
E. Example of LBE and Safety Classification Selection
F. PRA Technical Acceptability
G. Selection of Topics for Which Requirements are Needed
H. Applicability of 10 CFR 50
I. Guidance for the Formulation of Performance-Based Requirements
J. Example Requirements
K. Completeness Check

Glossary

- To provide a common understanding of the terms used in the framework

Examples:

- Abnormal Occurrence
  - an unscheduled incident or event which the Commission determines is significant from the standpoint of public health and safety
- Acceptance Criteria
  - criteria established by NRC regulation or other regulatory document that licensee must demonstrate by calculation or experiment is satisfied in order to obtain NRC approval to operate a nuclear facility
- Accident Mitigation
  - a strategy to reduce the severity of an accident
- Accident Prevention
  - a strategy to prevent an accident from occurring that could result in releases from the fuel
- Accident Sequence
  - a representation of an accident in terms of an initiating event followed by a combination of system, function and operator failures or successes that lead to a specified end state.

Stakeholder Presentations

Open Discussion

ANPR -- Plan

1. Is the proposed plan to make a risk-informed and performance-based alternative to 10 CFR Part 50 reasonable?
   - Is there a better approach than to create an entire new 10 CFR Part 53 to achieve a risk-informed and performance-based regulatory framework for nuclear power reactors?
   - If yes, please describe the better approach?

2. Are the objectives, as articulated above in the proposed plan section, understandable and achievable?
   - If not, why not?
   - Should there be additional objectives?
   - If so, please describe the additional objectives and explain the reasons for including them.

ANPR -- Plan

3. Would the approach described above in the proposed plan section accomplish the objectives?
   - If not, why not and what changes to the approach would allow for accomplishing the objectives?

4. Would existing licensees be interested in using risk-informed and performance-based alternative regulations to 10 CFR Part 50 as their licensing basis?
   - If not, why not?
   - If so, please discuss the main reasons for doing so.

ANPR -- Plan

5. Should the alternative regulations be technology-neutral (i.e., applicable to all reactor technologies, e.g., light water reactor or gas cooled reactor), or be technology-specific?
   - Please discuss the reasons for your answer.
   - If technology-specific, which technologies should receive priority for development of alternative regulations?

6. When would alternative regulations and supporting documents need to be in place to be of most benefit?

7. Is it premature to initiate rulemaking for non-LWR technologies?
   - If so, when should such an effort be undertaken?
   - Could supporting guidance be developed later than the alternative regulations, e.g. phased in during plant licensing and construction?

ANPR -- Plan

7. The NRC encourages active stakeholder participation through development of proposed supporting documents, standards, and guidance. In such a process, the proposed documents, standards, and guidance would be submitted to and reviewed by NRC staff, and the NRC staff could endorse them, if appropriate.

- Is there any interest by stakeholders to develop proposed supporting documents, standards, or guidance?
- If so, please identify your organization and the specific documents, standards, or guidance you are interested in taking the lead to develop.

ANPR – Part 50

64. Should the NRC continue with the ongoing current rulemaking efforts and not undertake any effort to risk-inform other regulations in 10 CFR Part 50, or should the NRC undertake new risk-informed rulemaking on a case-by-case priority basis? Why?

65. If the NRC were to undertake new risk-informed rulemakings, which regulations would be the most beneficial to revise? What would be the anticipated safety benefits?

ANPR – Part 50

66. In addition to revising specific regulations, are there any particular regulations that do not need to be revised, but whose associated regulatory guidance documents, could be revised to be more risk-informed and performance-based?

- What are the safety benefits associated with revising these guides?
- Which ones in particular are stakeholders interested in having revised and why?

67. If additional regulations and/or associated regulatory guidance documents were to be revised, when should the NRC initiate these efforts, e.g., immediately or after having started implementation of current risk-informed 10 CFR Part 50 regulations?

Breakout Sessions

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Breakout Sessions

- Are these the appropriate topics for the sessions?
- Are there other topics you would like to see?
- If yes, what are they?
- What session would you attend?
- Are you interested in attending more than one session?
- Other comments