United States Nuclear Regulatory Commission

Protecting People and the Environment

Applying Risk Insights in USNRC Reviews of Integral Pressurized Water Reactor Designs

Mark Caruso, Todd Hilsmeier, Thomas Kevern

U.S. Nuclear Regulatory Commission

Office of New Reactors

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Background

- USNRC is currently engaged in pre-application activities with two Integral Pressurized Water Reactor (iPWR) design vendors and one power company.
- Applications for Design Certification expected in CY 2012 (NuScale) and late CY 2013 (mPower).
- Application for Construction Permit expected CY 2013.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Background

- Commission directed the NRC staff (*ML102510405)* to more fully integrate the use of risk insights into pre-application activities and the review of small modular reactor (SMR) applications with near-term focus on iPWR designs.
- NRC staff has developed a framework for review of SMR designs that addresses the Commission's objectives. (*ML110110691, ML111320551)*
- Framework includes a graded approach for the review of SSCs based on risk significance and safety classification of SSCs.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

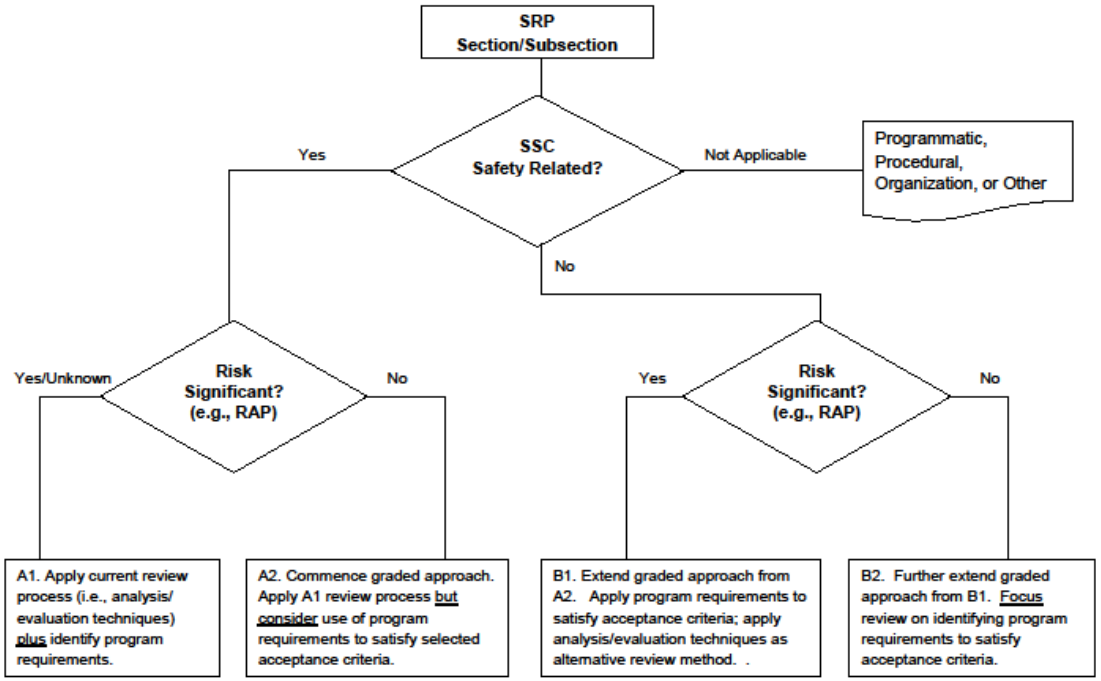
Approach

- Use risk insights to identify risk-significant SSCs and other aspects of the design that contribute most to safety

- Align review focus and resources to risk-significant SSCs and other aspects of the design that contribute most to safety to enhance the efficiency of the review process

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Process for Categorizing Review Activities



* For programmatic, procedural, organization, or other non-SSC topics (e.g., quality assurance, training, human factors engineering, health physics programs, operating procedures), the current review process is applied as provided in the SRP.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Aligning Review Focus and Resources with Risk-Significance

- Reduce amount of licensing review where possible for less risk-significant issues
- Utilize “regulatory controls” to supplement or replace performance-oriented acceptance criteria
- Reviews against design-related acceptance criteria remain unchanged.
- Regulatory Controls include:
  - Technical Specifications
  - Availability Controls
  - Initial Test Program
  - Maintenance Rule
  - Reliability Assurance Program
  - ITAAC

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Determining Risk-Significance

- The process of determining risk-significance of SSCs consists of the following four basic steps:
  1. Assembly of Design/Plant-Specific Information
  2. Identification of Plant Systems and System Functions
  3. Risk Significance Determinations for Systems Functions
  4. Update Risk Significance Determinations as necessary

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Determining Risk-Significance

Step 1: Assembly of Design/Plant-Specific Information

- Info from design-specific PRAs
  - Importance measures
  - Risk insights and key assumptions
  - SSCs associated with important operator actions or initiating events
- List of SSCs included in the Reliability Assurance Program (RAP)
- List of nonsafety SSCs that meet criteria for regulatory treatment of nonsafety systems (RTNSS)
- Technical Specifications

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Determining Risk-Significance

Step 2: Identification of Plant Systems and System Functions Addressed in SRP Acceptance Criteria

- System/System function is what is being categorized
- System function preferred (can have safety and nonsafety functions in same system)
- Systems and system functions are identified from info collected in Step 2.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Determining Risk-Significance

Step 3: Risk Significance Determinations for System Functions

- Approaches:
  - Use information from PRA if available (e.g., importance measures); preferred
  - Look at what is included in the RAP
  - Look at non-safety functions that will receive regulatory treatment (RTNSS)
  - Use RTNSS sensitivity studies (focused PRA) to find high risk-significant nonsafety functions

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Determining Risk-Significance

Step 4: Update Risk Significance Determinations

- In order to support guidance development for NRC reviews, categorization will be based on early information from an applicant's PRA.
- Applicant's PRA may change:
  - Design changes
  - Methods change
  - Errors corrected
  - Resolution of NRC review findings
- Categorization may need to be updated if the PRA changes

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Summary

- Framework for performing a risk-informed technical review of iPWR designs has been developed.
- Framework includes a graded approach for the review of SSCs based on risk significance and safety classification of SSCs.
- NRC will rely on assessments of risk-significance performed by the applicant, and its review of those assessments, for categorization of SSC related review activities.