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# Risk-Informed Applications and Reactor Oversight for New Reactors

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# Meeting Purpose

**Follow-up discussion of issues and high-level options regarding the implementation of risk-informed applications and reactor oversight at new reactors.**

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# Agenda

- Background and summary of previous discussions
- Reactor oversight issues
- Next steps

# Background: Risk-Informed Initiatives for New Reactors

- Risk-informed applications have been proposed:
  - Risk-Managed Technical Specifications
    - Risk-informed completion times
    - Surveillance frequency control program
  - Risk-informed inservice inspection of piping

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# Relevant Commission Policy Statements

- **Severe Reactor Accidents Regarding Future Designs and Existing Plants (1985)**
- **Regulation of Advanced Nuclear Power Plants (1986, 1994 & 2008)**
- **Commission Safety Goals (1986)**

# Commission's Expectations for New Reactors

## Severe Reactor Accidents Regarding Future Designs and Existing Plants (1985)

The Commission "fully expects that vendors engaged in designing new standard (or custom) plants will achieve a higher standard of severe accident safety performance than their prior designs."

## Regulation of Advanced Nuclear Power Plants (1986)

"Furthermore, the Commission expects that advanced reactors will provide enhanced margins of safety and/or utilize simplified, inherent, passive, or other innovative means to accomplish their safety functions."

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# Risk Goals for New Reactors

- **SECY-90-016 Staff Recommendations**
  - **Core damage frequency (CDF) < 1 x $10^{-5}$ /yr**
  - **Large release frequency (LRF) < 1 x $10^{-6}$ /yr**
  - **Conditional containment failure probability (CCFP) less than approximately 0.1**

- **In the associated staff requirements memorandum (SRM), the Commission disapproved the use of CDF <1 x $10^{-5}$ /yr and approved:**
  - **CDF < 1 x $10^{-4}$ /yr**
  - **LRF < 1 x $10^{-6}$ /yr**
  - **CCFP less than approximately 0.1**

# Risk Goals per SRM on SECY-90-016 (cont.)

- In response to staff recommendation on $10^{-5}$ /yr CDF and $10^{-6}$ /yr LRF goals, the Commission stated:
  - "Although the Commission strongly supports the use of the information and experience gained from the current generation of reactors as a basis for improving the safety performance of new designs, the NRC should not adopt industry objectives as a basis for establishing new requirements."

# Current Regulatory Guidance for Risk-Informed Initiatives

- Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis"

- Risk-Acceptance Guidelines:
  - Baseline risk metrics of CDF and large early release frequency (LERF)

    AND
  - ΔCDF and ΔLERF due to change

- Basis:
  - Increases should be limited to small increments
  - CDF threshold related to backfit regulatory analysis guidelines
  - ΔCDF limit based on *absolute* change and set close to limit of resolution of probabilistic risk assessment (PRA) models

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# From RG 1.174

- **Five principles for making risk-informed decisions**
  - **The proposed change:**
    - **Meets current regulations (presumption of adequate protection)**
    - **Is consistent with the defense-in-depth philosophy**
    - **Maintains sufficient safety margins**
    - **Results in an increase in CDF or risk that is small and consistent with the intent of the Commission's Safety Goal Policy Statement**
    - **Will be monitored using performance measurement strategies.**

# NEI White Paper of 3/29/09 (ML090900674)

Industry stated that the introduction of new risk metrics or thresholds could create a number of issues:

1. Inconsistency with Commission Policy
2. New Risk Metrics Would Penalize Safer Plants
3. New Risk Metrics Would Create Public Perception Problems
4. New Risk Metrics Values Could be Associated with High Uncertainties
5. Current Risk Metrics are also Supported with Additional Requirements
6. New plants are Subject to a Comprehensive Change Control Process with explicit consideration of severe accidents
7. Current Risk Metrics Contain Deterministic Backstops
8. Risk Profile for New Reactors is Not Yet Complete

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# Some Views of Dr. Edwin Lyman of UCS During 6/2/09 Meeting with ACRS Subcommittee (ML092040138)

- If one pursued the *status quo*, then the entire approach of risk-informed changes to the licensing basis is not going to make any sense. A new reactor with a core damage frequency of $10^{-7}$ /yr could dismantle major safety systems and still meet the guidance.
- New reactors do appear on paper to be safer than the current reactors and the public should get the benefit of that. If changes are made then the relative risk increase should be small whether it's a CDF of $10^{-7}$ or a CDF of $10^{-5}$.

# High-level Options for Changes to the Licensing Basis

**Option 1:** No change to the risk-informed framework for changes to the licensing basis. *(status quo)*

**Option 2:** Modify the risk-informed framework for changes to the licensing basis to explicitly address the need to evaluate the impact on those features added for enhanced safety.

# Option 1 Advantages

- Provides a consistent set of acceptance guidelines for both existing and new reactors.
- Is consistent with the bases for RG 1.174 acceptance guidelines that are derived from Commission's 1986 Safety Goals.
- Would not impose additional requirements on new reactors.
- Acknowledges and gives credit to new reactors for lower risk estimates.

# Option 1 Disadvantages

- **May not be consistent with Commission's 1985, 1986, and 1994 Policy Statements on expectations that new reactor designs will achieve a higher standard of severe accident safety performance.**
- **Could result in less restrictive change process than the Commission established for the review of new reactors.**
- **Could allow large *relative* increases in CDF and risk compared to the baseline CDF and risk estimates for new reactor designs.**

# Option 2 Advantages

- **Remains consistent with Commission's Policy Statements on expectations that new reactor designs will achieve a higher standard of severe accident safety performance.**
- **Acknowledges that new reactor CDF and risk estimates are significantly lower than existing reactors and adjusts acceptance guidelines in RG 1.174 accordingly.**
- **Would substantially maintain the plant risk profile previously reviewed by the staff and documented in the safety evaluation report (SER).**

# Option 2 Disadvantages

- **May be inconsistent with the underlying technical basis for the current *absolute* thresholds in RG 1.174 in that more stringent acceptance guidelines for changes are imposed.**

- **May be viewed as posing new *de facto* safety goals or subsidiary objectives on new reactors.**

- **May be viewed as penalizing new reactors for having lower risk.**

- **New reactors licensed under Part 52 already have a comprehensive change control process with respect to severe accident capabilities. Changes to fundamental plant design are subject to prior NRC review and approval.**

# Reactor Oversight Process

## Background

- SECY-99-007 proposed a revised ROP using seven cornerstones of safety. Fundamental to this concept was that licensee performance that met the objectives and key attributes of each of these cornerstones would provide reasonable assurance that public health and safety was maintained.

- Licensee performance within each cornerstone is measured by a combination of performance indicators (PIs) and inspection findings (IFs). PIs and IFs are equal-weighted in the Action Matrix.

- PIs were developed for each of the cornerstones to provide an objective indication of licensee performance. Risk insights were used to established thresholds, where permitted.

- The risk-informed baseline inspection program uses a significance determination process that is based on risk insights (RG 1.174) developed from the current Commission policy on risk safety goals.

# Reactor Oversight Process

## Purpose

- The objective of the ROP was to provide a tool for inspecting and assessing licensee performance in a manner that was more risk-informed, objective, predictable, and understandable than the previous oversight process. (ROP Basis Document, Inspection Manual Chapter (IMC) 0308)

- The intent of the ROP's defining principles was to result in an oversight process that provides adequate margin in the assessment of licensee performance so that appropriate licensee and NRC actions are taken before unacceptable performance occurs. (SECY 99-007)

- The performance thresholds should be risk informed to the extent practical, but should accommodate defense-in-depth and indications based on existing regulatory requirements and safety analyses. (SECY 99-007)

# Reactor Oversight Process

**CURRENT IMPLEMENTATION MODEL FOR EVALUATING LICENSEE PERFORMANCE**
**(from ROP Basis Document, IMC 0308)**

## GREEN

***Licensee Response Band***

**Cornerstone objectives fully met. Nominal risk with nominal deviation from expected performance**

## WHITE

***Increased Regulatory Response Band***

**Cornerstone objectives met with *minimal* reduction in safety margin. Changes in performance consistent with $\Delta CDF < 10^{-5}$ ($\Delta LERF < 10^{-6}$).**

## YELLOW

***Required Regulatory Response Band***

**Cornerstone objectives met with *significant* reduction in safety margin. Changes in performance consistent with $\Delta CDF < 10^{-4}$ ($\Delta LERF < 10^{-5}$)**

## RED

***Significant Regulatory Response Band* |**

**Plant performance represents an unacceptable loss of safety margin. It should be noted that should licensee's performance result in a PI reaching the Red Band, margin would still exist before an undue risk to public health and safety would be presented.**

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# High-level Options for the Reactor Oversight Process

**Option 1:** No change to the Reactor Oversight Process (ROP). *(status quo)*

**Option 2:** Modify the ROP thresholds so that substantial departures of structures, systems, and components (SSC) performance are identified.

# Reactor Oversight Process

## Pros for maintaining the current oversight program

- Provides a consistent set of ROP thresholds for both existing and new reactors.
- Is consistent with the risk-informed concept that the allocation of inspection resources under the ROP should be commensurate with the risk-significance of the performance issue.

## Cons for maintaining the current oversight program

- Could allow substantial departure of SSC performance from the norm before the threshold for NRC interaction is reached.
- Could raise concerns regarding the insensitivity of the mitigating systems performance index (MSPI) and significance determination process (SDP) findings under the ROP.
- Could impact public confidence in NRC's ability to make meaningful distinctions in performance among new reactors.

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# Reactor Oversight Process

## Pros for modifying the ROP thresholds in the new ROP

- **Allows earlier interaction of staff with the licensee for SSC performance that is indicative of being substandard and outside the norm.**
- **Acknowledges that there are margin of safety and defense-in-depth considerations beyond the strict risk-informed numerical thresholds in the ROP.**
- **Acknowledges that the current risk-informed thresholds were developed without the foresight of a full understanding of the risk profiles of new reactors.**

## Cons for modifying the ROP thresholds in the new ROP

- **Using different ROP thresholds for currently operating and new reactors could cause public perception problems, especially when the two designs are co-located at the same site.**

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# Next Steps

- **Staff to take a position and develop draft Commission Paper (fall 2009)**
- **Additional discussions with Advisory Committee on Reactor Safeguards (ACRS) (late fall 2009)**
- **Commission Paper (late 2009 / early 2010)**

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# Back-up slide

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# From RG 1.174

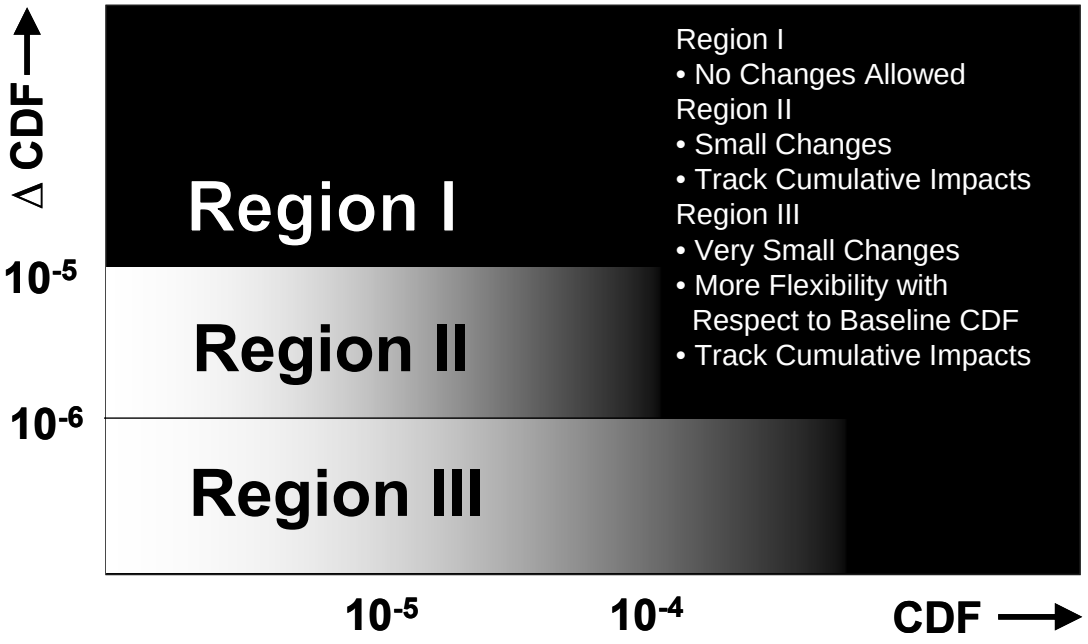


**Figure 3. Acceptance Guidelines for Core Damage Frequency (CDF)**

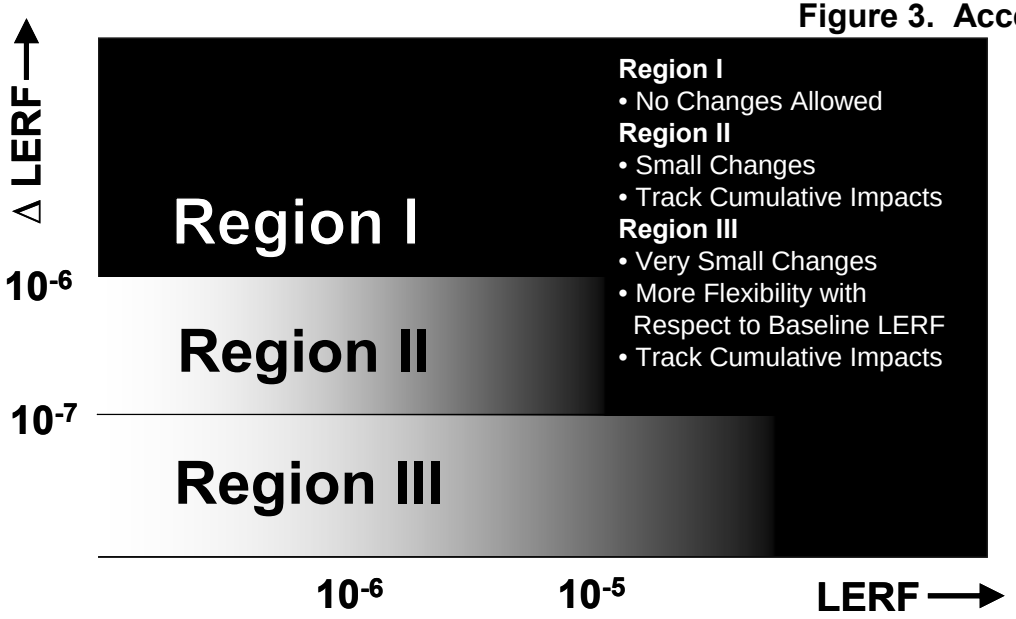


**Figure 4. Acceptance Guidelines for Large Early Release Frequency (LERF)**