



Risk-Informed Emergency Core Cooling Requirements (10 CFR 50.46a)

March 24, 2011

Speakers and Topics

- **Opening: Bill Borchardt, EDO**
- **Introduction: Eric Leeds, NRR**
- **Rule Concept and Staff Views:
William Ruland, NRR/DSS**
- **Background and Rule Requirements:
Richard Dudley, NRR/DPR**
- **Generic Supporting Studies:
Rob Tregoning, RES/DE**

Summary of Rule Concept; Staff Thoughts on Issuance

William Ruland

**Director, Division of Safety
Systems**

**Office of Nuclear Reactor
Regulation**

§ 50.46a Final Rule Concept

- **Alternative to existing ECCS requirements (§ 50.46)**
- **LOCAs divided into 2 regions based on break frequency – by transition break size (TBS)**
- **Requirements unchanged for 1st region (\leq TBS)**

§ 50.46a Final Rule Concept

- In 2nd region (> TBS) LOCA mitigation requirements relaxed for lower frequency breaks**
- Plant changes “enabled” by new requirements also evaluated by a risk-informed process**

§ 50.46a Final Rule Concept

- **Transition break size**
 - **PWRs – largest attached pipe to the main coolant piping**
 - **BWRs – largest attached feedwater or residual heat removal line inside containment**

ECCS Analysis Requirements

- **Breaks \leq TBS**
 - **No change from current §50.46**
- **Breaks $>$ TBS**
 - **No single failure assumption**
 - **Credit for offsite power**
 - **Credit for non-safety equipment**
 - **Acceptance criteria: coolable geometry & long term cooling**

Staff Views on §50.46a Rule

- **Maintains adequate protection**
- **Provides design and operational flexibility**
- **Incorporates stakeholder input**
- **Regulatory analysis shows large potential benefits**

Staff Views on § 50.46a Rule

- **Risk assessment requirements consistent with Risk-Informed Fire Protection - 10 CFR 50.48(c)**
- **Design constraints consistent with ACRS recommendations on defense-in-depth**

Staff Views on §50.46a Rule

- **Rule has been much debated**
- **Base changes on experience**
- **Investment to evaluate benefits is unlikely until rule is issued**
- **Potentially useful for GSI-191**

Staff Views on §50.46a Rule

- **Uncertainties are important**
- **Frequency curves developed by expert judgments based on best available information**
- **Rule developed in consideration of uncertainties associated with rare events**

Stakeholder Concerns

- **Burden for beyond TBS breaks not commensurate with safety significance**
- **TBS too large**

Stakeholder Concerns (con't)

- **Requirements should not be relaxed until ECCS acceptance criteria in 50.46(b) are finalized**
- **Current ECCS models and criteria are non-conservative and therefore relaxing other input conservatisms is unsafe**

Background and Rule Requirements

Richard Dudley

Senior Project Manager

Division of Policy and Rulemaking

Office of Nuclear Reactor

Regulation

Background

- **Proposed rule November 2005**
- **Industry commented on rule burden**
- **2 public meetings**
- **November 2006 ACRS concerns on defense-in-depth**
- **Current rule balances safety with essential burden**

Overview of § 50.46a Rule Process and Requirements

Conversion to §50.46a

- **Demonstrate applicability of expert elicitation report and seismic study**
 - **To ensure the generic conclusions on adequate safety apply**
- **NRC must review and approve licensee's application**

For Changes Enabled by § 50.46a

- **Re-analyze ECCS for the new configuration**
- **For non-safety equipment credited in >TBS analysis:**
 - **List in Administrative Controls section of Tech Specs (no LCOs)**
 - **Provide capability for on-site power**

For Changes Enabled by § 50.46a

- **Perform risk-informed evaluation**
 - **Demonstrate adequacy of:**
 - **defense-in-depth**
 - **safety margins**
 - **monitoring program**
 - **Demonstrate that risk acceptance criteria are met (“very small”)**

Operational Requirements

- **Review all future plant changes to ensure applicability of generic studies**
- **Periodically confirm via PRA update that total risk increase “very small”**
- **Do not operate in condition not meeting > TBS acceptance criteria for more than a short time**

Applicability to New Reactors

- **Can use rule if new reactor is “similar” in design and operation**
- **Applicant must propose and justify**
 - **“similarity” and appropriate TBS**
- **NRC design-specific review**
 - **approve similarity and TBS**

Generic Studies Performed to Support Determining the Transition Break Size

**Robert Tregoning
Senior Advisor for Materials
Division of Engineering
Office of Nuclear Regulatory
Research**

Background

- **March 2003 SRM directed staff to estimate LOCA frequencies**
 - **Realistically conservative**
 - **Incorporate margins for uncertainty**
- **LOCA frequencies documented in NUREG-1829**

NUREG-1829: Scope and Significant Assumptions

- **Scope: Generic BWR and PWR passive-system LOCA frequencies**
- **Assumptions**
 - **Typical plant history and operation**
 - **No future plant changes that affect LOCA frequencies**

NUREG-1829: Results

- **Panelists provided quantitative estimates supported by rationale**
 - **Rationale: Good agreement**
 - **Estimates: Large uncertainty**
- **Results sensitive to aggregation scheme**

NUREG-1829: Use of Results

- **Use in § 50.46a**
 - **Starting point for TBS values**
 - **Account for other considerations**
 - **Promote regulatory stability**
- **Additional staff evaluation**
 - **Assessed other LOCA contributors**
 - **Evaluated risk due to seismic events**

NUREG-1903: Scope and Significant Assumptions

- **Scope: Determine if seismic risk is acceptable for breaks > TBS**
- **Assumptions**
 - **Plant information remains applicable**
 - **Stresses associated with rare seismic event are representative**

NUREG-1903: Results

- **Direct piping failures**
 - **Negligible risk if piping is not degraded**
 - **Flaws leading to failure in degraded piping are expected to be large**
- **Indirect piping failures**
 - **Acceptable risk for two plants studied**
 - **Results are highly plant-specific**

NUREG-1903: Use of Results

- **Use in § 50.46a**
 - **Risks of seismically induced LOCAs are expected to be acceptable**
 - **TBS selection is appropriate**
- **Limitations**
 - **Analyses may not be applicable**
 - **Indirect failure risks not generically evaluated**

Regulatory Guide Development

- **DG-1216 published for comment**
 - **Maximizes use of prior submittals**
 - **Provides multiple options**
- **Stakeholder comments**
 - **Guidance is too complex**
 - **Costs may limit application of rule**
- **Pilot plant study proposed**

Acronyms

NRC – Nuclear Regulatory Commission

ECCS – emergency core cooling system

TBS – transition break size

LOCA – loss of coolant accident

PWR – pressurized water reactor

BWR – boiling water reactor

DBA – design basis accident

LCO – limiting conditions for operation

Acronyms

ACRS – Advisory Committee on Reactor Safeguards

GSI – Generic Safety Issue

PRA – probabilistic risk assessment

CFR – Code of Federal Regulations

RG – Regulatory Guide

Backup

Optional Self-Approval Process

- **If self-approved change process is desired, submit risk-informed process**
- **Criteria for self-approved changes:**
 - **“minimal” risk increase**
 - **§ 50.59 is satisfied**

Backup

Applicability to New Reactors

- **Risk change acceptance criteria**
 - **Same as current plants, but further limited to not allow significant reduction in level of safety provided by new Part 52 design**