

Comments by R. Barnett
& M. Rubin
4/4/2000



ADVISORY COMMITTEE ON REACTOR SAFEGUARDS BRIEFING

ON

**Draft Final Technical Study of Spent Fuel Pool Accident Risk
at Decommissioning Nuclear Power Plants**

**Glenn B. Kelly
Probabilistic Safety Assessment Branch
Office of Nuclear Reactor Regulation**

April 5, 2000

6/2/05

4/5

TECHNICAL CONTRIBUTORS

NRR

RES

Coordination:

**Diane Jackson
Tanya Eaton
George Hubbard**

Risk Assessment:

**Glenn Kelly
Michael Cheok,
Gareth Parry
Mark Rubin**

Nathan Siu

Seismic:

**Goutam Bagchi
Robert Rothman**

**Nilesh Chokshi
Robert Kennedy (consultant)**

Criticality:

**Larry Kopp
Anthony Ulises**

T-H:

Joseph Staudenmeier

Christopher Boyd

Consequences:

Jason Schaperow

TECHNICAL CONTRIBUTORS
(Cont.)

Heavy Loads: Edward Throm

Safeguards: Robert Skelton

EP: James O'Brien

BACKGROUND AND STATUS

- **June 1999 preliminary draft report concluded that:**
 - **Zirconium fires can occur for several years after shutdown**
 - **The offsite consequences are very high**
 - **Frequency about $2E-5$ per year. Dominated by human error**

- **Extensive scrutiny by industry and other stakeholders; NRC sponsored technical review of preliminary draft**
- **Industry committed to design and operational actions, and proposed a seismic checklist**
- **Risk has been requantified and draft report prepared**
- **Draft-for-comment issued 2/15/00**

TECHNICAL RESULTS

- **In current draft report, risk is reduced significantly due primarily to industry commitments**
 - **Human-error driven sequences reduced to about 2E-7 per year**
 - **Heavy load sequences reduced to about 2E-7 per year**

TECHNICAL RESULTS

(Cont.)

- Seismic failure frequency bounded by $3E-6$ per year, but not fully quantified due to seismic checklist approach**
- Overall risk reduced by about an order of magnitude**
- Criticality issue and most stakeholder comments addressed**

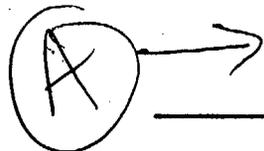
TECHNICAL RESULTS

(Cont.)

- **NRC analysis to date shows that zirconium fires will generally not be possible after 5 years. Acceptance of shorter times would require plant-specific analysis**

COMPARISON WITH OTHER RISK MEASURES AND RESULTS

- **Decommissioning reactor
large release frequency:** **<3E-6**
- **RG 1.174 large early release (LERF)
baseline guideline (above which
only a small increase in risk will
be allowed):** **1E-5¹**



¹ For evaluation of EP options, the distinction between early and late release is important because of the extra time available for offsite protective actions without preplanning. However, for indemnification, this distinction makes little or no difference, because it is the size of the release, not the timing, which determines the extent of offsite impact.

Results Comparison (Cont.)

- Oversight process LERF threshold for “yellow” finding:

Δ 1E-6

SECT 99-007

- LERF guideline for “substantial increase in protection”:

Δ 1E-6

Regulatory Assessment Guidelines

SD.109

(rough guidelines)

D10-5 CDF
D10-6 LERF

+ cost effective

- Range of IPE LERF estimates:

2E-6 to 2E-5

To A

THREE PHASES OF A SPENT FUEL POOL

- **IMMEDIATELY AFTER PLANT SHUT DOWN:**

Large early offsite release due to zirconium fire possible.

Design basis systems and operating practices retained. Full requirements for EP, indemnification, and security in place

- **EARLY DECOMMISSIONING PHASE**

Large late releases possible. Relaxation of EP requirements justified technically.

Meeting industry commitments, seismic checklist, and staff assumptions required.

Frequency of large releases within RG 1.174 guidance that allows for small increases in risk. NRC might consider insurance relief.

Staff analyzed pools with one year of cool down, but shorter times might be justified.

- **ZIRCONIUM FIRES NO LONGER POSSIBLE:**

Report justifies 5 years. Shorter times might be justified plant-specifically

There may be technical justification for elimination of Offsite EP and insurance requirements in this phase

RISK INFORMED-DECISION MAKING

This number was used as the proposed PPG.

- **Baseline risk and changes to risk**

Having or not having an impact on LERF. Security handled by identifying areas that are

Regulatory Guide 1.174 uses a baseline frequency of 1E-5 per year for LERF-like hazards above which only extremely small increases in LERF will be accepted. The SFP zirconium fire frequency estimated in the draft report is less than 1E-5 per year. There are no proposals for regulatory relief that would lead to changes in this frequency.

calculated

- **Margin**

Thermal inertia of fuel and SFP volume give significant time for heat up to a zirconium fire.

- **Defense in Depth (DID)**

Given the margin in SFPs, DID is not a major issue. However, given risk analysis findings including uncertainties, the technical results provide justification for retaining a baseline level of EP, including procedure to classify accidents and notify offsite authorities.

In the late decommissioning phase, there is no technical basis for retaining EP.

- **Monitoring performance**

Licensees should monitor characteristics important to controlling risk, including industry commitments, staff assumptions, and seismic checklist.

IMPACT ON RULE MAKING

- **Slow evolution of release justifies reduction in EP requirements. Risk insights and defense-in-depth considerations indicate need for retaining a baseline EP capability.**
- **Risk analysis does not justify reduction in security function. Reduction of requirements might be justified on the basis of reduced complexity**
- **Current report does not take a position on indemnification. The frequency of zirconium fire is not “incredible,” but may be low enough for the commission to conclude that licensees could be relieved from insurance requirements. However, some operating plants have comparably low frequencies of large releases.**

- **Rule making should include requirement to monitor performance in areas important to risk.**
- **In the late decommissioning phase, there is no technical basis for retaining EP. The draft report did not directly address indemnification issues.**