Quantifying Reactor Accident Risk: A History

Panel W20: The Metamorphosis to a More Risk-Informed Regulator

Tom Wellock
NRC

Risk-Informed, Performance-Based

• A “New Paradigm”
  – Efficiency
  – Safety Significant
  – Relieve Regulatory Burden

• PRAs: “Significant Limitations”
  – Industry-NRC gap
  – Methodology
  – Data
  – Peer Review

• New Safety Issues

Three Ds of the Deterministic Era

– Deterministic Design

– Design Basis Accidents

– Defense-in-Depth
  • Inherent Safety
  • Active Systems
  • Siting
  • Static Layers (containment)
WASH-1400 and the Roots of PRA

- Methodology: Models and Goals in the 1960s
- Regulatory Necessity
- Political Necessity

Accident Modeling in the 1960s
Farmer Curve
Chauncey Starr

New Safety Issues

- Loss of Coolant and the China Syndrome
  - ECCS

- Anticipated Transient Without Scram
  - Beyond the Design Basis Accident
  - Need for regulatory risk expertise

AEC Under Siege

- Anti-nuclear Movement
- Environmental Protection Agency
  - Class 9 accidents
  - Growing interest in risk
- Congress

Henry Kendall, UCS
WASH-1400: Positives

- New tool for regulators
- A spectrum of accidents
- Core damage more likely but lower consequences

WASH-1400: Negatives

- Large error bands
- Inappropriate comparisons to other risks
- Some accidents not analyzed
- Lacked adequate peer review
- Lewis Committee (1978)
WASH-1400, Executive Summary

UCS Critique of WASH-1400

Three Mile Island and WASH-1400

- Human factors and operations
- Severe accidents
- Safety systems other than ECCS

TMI Control Room, March 1979
1980s: Beneficially Unfocused

- Beyond the Design Basis: ATWS, SBO, severe accidents
- Unresolved Questions: Generic issues, older plants
- Operating Reactors: Evaluating events
- New Reactors: Design certification
- Methodology: Industry PRAs and NUREG-1150
- Goals: Safety Goal Policy and Backfits

Toward Risk-Informed Regulation, 1990s

- Individual Plant Examinations
- Towers-Perrin Report
- Maintenance Rule

References


References (cont.)

• Slide 9: Archive of the Norfolk Charitable Trust, Sharon, MA.
• Slide 14: Sierra Club and Union of Concerned Scientists, Preliminary Review of the AEC Reactor Safety Study (San Francisco-Cambridge, December 1974), 1008.

Acronyms

• ATWS: Anticipated Transient Without Scram
• ECCS: Emergency Core Cooling System
• PRA: Probabilistic Risk Assessment
• SBO: Station Blackout
• UCS: Union of Concerned Scientists
• WASH: AEC Headquarters, Washington, DC