

NRC Proposed Approach

for

High-Level Waste Regulations

Outline

- **National Academy of Sciences Recommendations**
- **NRC Approach for Regulation**
- **Preclosure Criteria**
- **Postclosure Criteria**

National Academy of Sciences (NAS) Report:

“Technical Bases for Yucca Mountain Standards”

- Issued pursuant to the Energy Policy Act of 1992 (EnPA)
- Under EnPA
 - Environmental Protection Agency (EPA) must issue new standards for Yucca Mountain that are health-based based on and consistent with NAS recommendations only such standards applicable to Yucca Mountain final standards were to have been in place by 8/1/96
 - NRC regulations must conform to final EPA standards within one year

NAS Findings and Recommendations

NAS issued a report in August 1995 that:

- Advised EPA on technical basis for Yucca Mountain Standards
- Addressed 3 specific issues required by Energy Policy Act of 1992
 - adequacy of an individual dose standard
 - validity of estimates of the probability of intrusion
 - reliability of institutional controls to prevent intrusion
- Also commented on NRC implementation issues

NAS Responses on Specific Issues

- Individual protection standard, expressed as a limit on individual risk, is protective
- Not reasonable to assume institutional controls will prevent human intrusion from occurring
- Not possible to make scientific predictions for nature and timing of human intrusion

NAS Recommendations

- Limit risk to average member of critical group
 - starting point for standard equivalent to 0.02 to 0.2 mSv
 - international consensus 0.05-0.3 mSv/yr
- Define reference biosphere and critical group characteristics by rule
- Evaluate consequences of human intrusion separately using a stylized calculation
- Avoid quantitative subsystem requirements
- Conduct assessment for time of peak risk (within limits of geologic stability)
 - no **scientific** basis for limiting the time period

Regulatory Approach

- Risk-informed, performance based criteria
 - preclosure and postclosure performance objectives
 - compliance based on quantitative analyses of system performance
 - no additional quantitative measures (e.g., subsystem requirements)
- Geologic repository must include a system of multiple barriers
- Limit potential for speculation during licensing
- Specify assumptions and characteristics for selection of reference biosphere and critical group
- Specify calculation and assumptions for consequence analyses of human intrusion event

Proposed Preclosure Criteria

- Public dose limit of 1 mSv/year, occupational dose limit of 50 mSv/year (10 CFR Part 20)
- Individual dose limit of 0.25 mSv/year during normal operations
- Individual dose limit of 50 mSv/event for design basis events

Preclosure Safety Assessment

- Comprehensive, systematic, and quantitative safety analysis
- Identifies hazards and potential event sequences
- Integrates fire protection, radiation safety, criticality safety, and chemical safety
- Analysis of performance of major design structures, systems, components (both surface and subsurface)

Proposed Postclosure Criteria

- Individual dose limit of 0.25 mSv/year to the average member of the critical group
- Events to be considered if at least 1 chance in 10,000 of occurring in 10,000 years
- Repository to include at least one natural and one engineered barrier
- Specified intrusion shall meet the 0.25 mSv/year limit

Postclosure Safety Assessment

- Comprehensive, systematic, and quantitative safety analysis
- Identifies features, events, and processes that can affect repository performance
- Integrates site characterization and repository design
- Analysis of the capabilities of barriers important to waste isolation
- Performance confirmation program required

Individual Dose Limit

- Only quantitative limit for postclosure performance
- Consistent with Commission direction and regulation of other related activities
 - LLW specifies 0.25 mSv
 - decommissioning specifies 0.25 mSv
 - international limits typically vary between 0.05 and 0.3 mSv
 - NAS recommended starting point of 0.02-0.2 mSv
- Expected annual dose
 - calculated for each year
(a curve of expected annual dose versus time after closure)
 - accounts for probability of the scenarios and probability of the parameters
 - representative of risk to an individual

Compliance Period of 10,000 Years

- Provides for analysis of wide range of geologic conditions and degradation processes of the engineered barriers
- Radiological hazard of waste decreases significantly over 10,000 years (within an order of magnitude of “similar” ore body)
 - anticipate that peak dose would occur beyond 10,000
- Consistent with court ruling and other regulations
 - Court of Appeals upheld EPA selection of 10,000 year compliance period for 40 CFR 191
 - WIPP (40 CFR 191)
- Uncertainties of analyses beyond 10,000 years call into question the usefulness of these results for compliance determination

Reference Biosphere and Critical Group

- Arid to semi-arid conditions
- Farming community located approximately 20 km from site
 - consistent with present knowledge and conditions
(depth to water table, diet includes some locally produced food)
- Land use, lifestyle, diet, human physiology, and metabolics assumed constant over time
 - limits speculation

Defendable Performance Assessment

- Include site data to define all relevant parameters and models
- Account for uncertainties
- Consider alternative models and provide basis for models used
- Consider events with an annual probability of 10^{-8} or higher
- Consider degradation, deterioration, or alteration of engineered barriers
- Support topics most important to performance with greatest rigor

HUMAN INTRUSION

- Evaluate consequences of “stylized” intrusion in context of total system performance
- Assume a single vertical borehole that penetrates one waste package and creates a pathway to the saturated zone
 - limits speculation
- Consistent with NAS recommendations