Time of Compliance

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Introduction

- Majority of radioactivity in LLW will decay within a few hundreds of years
- Presence of long-lived contaminants is not unique to LLW (e.g., metals in hazardous waste, NORM)
- Risk-informed, performance-based approach requires an appropriate time frame for quantitative compliance
- Selection of a "time of compliance" is a science and policy decision, considering factors such as intergenerational equity and resource allocation

DOE Position on Time of Compliance for LLW Disposal

DOE uses a two-tiered approach to time frames reflecting a transition in application and interpretation of results:

≤ 1,000 years – Calculated doses are used for regulatory compliance and compared to quantitative dose/concentration/flux constraints

> 1,000 years – Evaluate model stability and consider potential for catastrophic impacts. Support risk-informed decision-making recognizing increasingly speculative and uncertain assumptions.

Basis for Position

1,000 year time of compliance based on multiple factors, for example:

- Role of PA as only one contributor to the overall safety basis,
- Considerations related to intergenerational equity and resource allocation
- Decreasing relevance/usefulness of increasingly speculative and uncertain information for decision-making
- International recommendations and approaches
- Promulgated rules addressing near-surface disposal (e.g., 10 CFR Part 20, 10 CFR Part 40 (40 CFR 192)).

NAS Recommendations

Recommendations from the National Academy of Sciences (NAS) emphasized the role of modeling to build understanding, rather than predicting:

> *"[A] scientifically sound objective of geological modeling is learning over time, how to achieve the long-term isolation of radioactive waste. That is a profoundly different objective from predicting the detailed structure and behavior of a site…it is the latter use to which models have been put. The Board believes that this is scientifically unsound." (NAS 1990)*

NAS Recommendations

Subsequent NAS recommendations identified the presence of policy aspects that had not been addressed and noted the lack of a scientific basis for selecting a time of compliance:

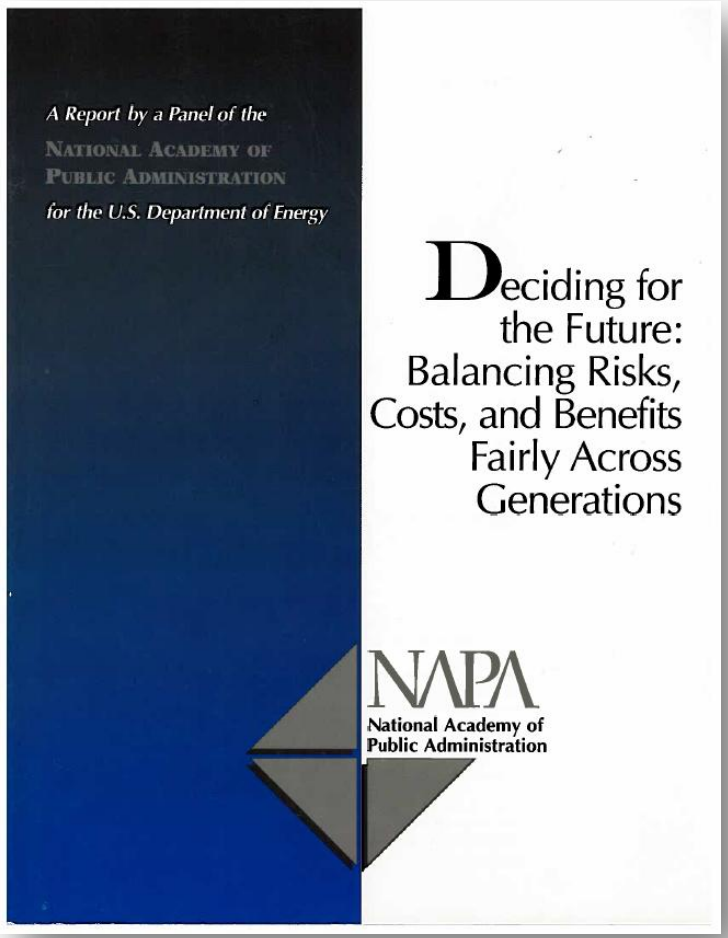
> *"[W]e believe that there is no scientific basis for limiting the time period of the individual-risk standard to 10,000 years or any other value."*
>
> *"[W]e note that although the selection of a time period of applicability has scientific elements, it also has policy aspects that we have not addressed." "Another … issue is intergenerational equity." (NAS 1995)*

NAPA Study

As a follow-up to the findings from the NAS, DOE requested a study by the National Academy of Public Administration to address policy considerations (published in 1997)

The study included:

- Exhaustive literature survey
- Stakeholder workshop
- Expert panel



NAPA Study Key Principles

- **Trustee Principle** - Every generation has obligations as trustee to protect the interests of future generations.
- **Sustainability Principle** - No generation should deprive future generations of the opportunity for a quality of life comparable to its own.
- **Chain of Obligation Principle** - Each generation's primary obligation is to provide for the needs of the living and succeeding generations. Near-term concrete hazards have priority over long-term hypothetical hazards. (rolling present)
- **Precautionary Principle** - Actions that pose a realistic threat of irreversible harm or catastrophic consequences should not be pursued unless there is some compelling countervailing need to benefit either current or future generations.

NAPA Study Findings

- Near term considered to be 2 - 4 generations. Distant future – 500 or 1,000 years.
- "Future impacts should be weighted differently from impacts on the present generation."
- "[I]t is inappropriate to use traditional economic discounting formulas over long time periods …"
- "Consideration of the needs of the future does not entitle anyone to impose an injustice on the present generation. In general, the literature related to intergenerational equity clearly opposes making trade-offs favoring the future that fail to meet crucial obligations to present generations, or that impose an injustice on the present."

NAPA Principles Application

- Time of compliance is not simply a matter of science but a public administration issue that needs to be selected to support good decisions
- It is question of intergenerational equity and resource allocation
- The goal should be to expend current resources to maximize benefit to current and future generations

Considerations

- Dose limits based on current assessment of risk and needs
- Activities that generate waste are beneficial to both the current and future generations
- Future state of society and technology will change significantly over the next 100, let alone thousands of years
- Uncertainty in calculations is very large beyond a few hundred years

Perspective on Changes over Time

Time Period	Event/Activity
Approx 10,000 years ago	Glacial period ending. Hunting Mammoths
1862	Internal Combustion Engine
1903	Wright brothers
1969	Man on moon
	Top 3 Causes of Death
1900	Pneumonia, Tuberculosis, Diarrhea (Cancer # 8)
2001	Heart disease, Cancer, Cerebrovascular (Pneumonia #9, TB .02% of all, Diarrhea not listed)

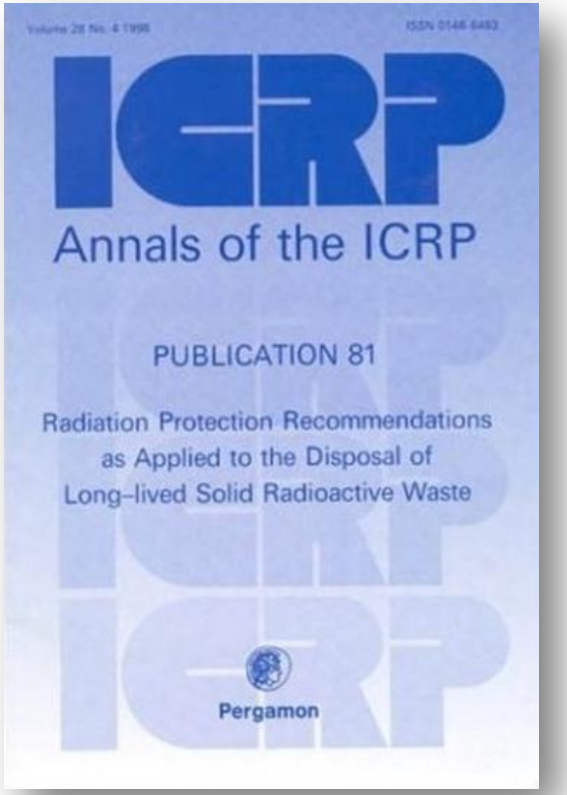
Costs of Excessive Time of Compliance

- Not just added PA computer run time
- Additional site characterization and research to defend increasingly speculative assumptions
- Schedule delays
- Extended licensing hearings
- Litigation
- Cost of elaborate barriers
- Less than optimal use of existing disposal facilities

Invest in risk assessment or risk reduction ?

International Perspectives (ICRP)

- ICRP Publication 81 perspective on time frames
  - *"Doses and risks, as measures of health detriment, cannot be forecast with any certainty for periods beyond around several hundreds of years into the future"*
  - *"To evaluate the performance of waste disposal systems over long time scales, one approach is the consideration of quantitative estimates of dose or risk on the order of 1000 to 10,000 years."*

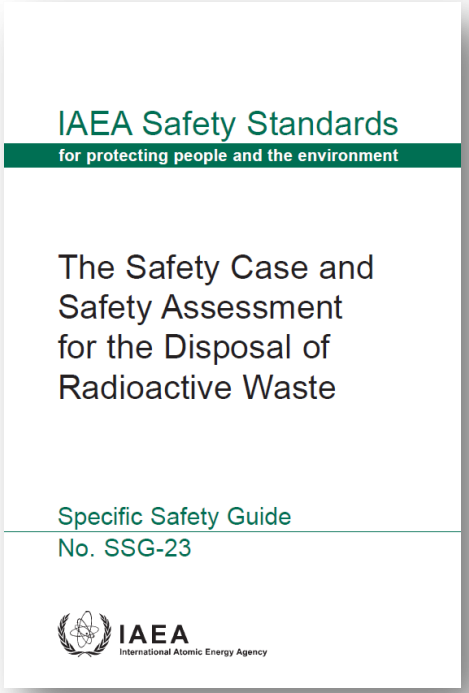


**ICRP 81 addresses geologic and near surface disposal*

International Perspectives (IAEA)

IAEA Safety Guide addresses meaningfulness of calculations for waste disposed on the surface or near the surface

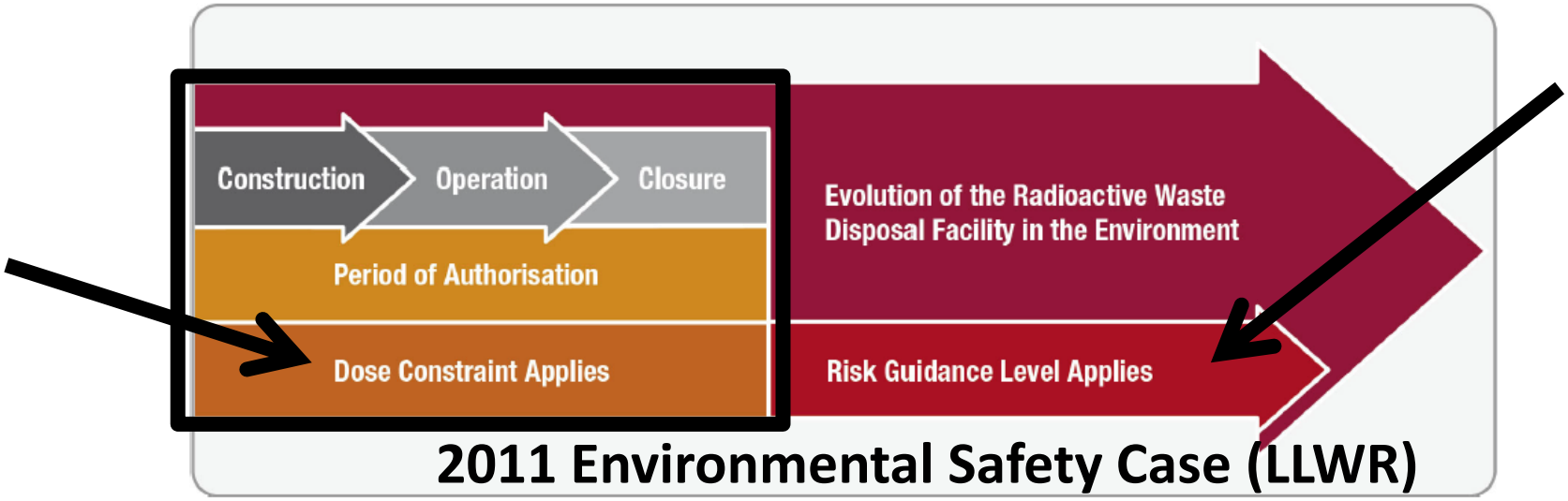
– *"For above surface disposal facilities (e.g. for waste from mining), the uncertainties in modelling results will already be substantial when considering periods of several hundred years, and quantitative estimates may become meaningless already beyond a period of a thousand years. For engineered near surface disposal facilities, which are subject to processes that may affect their integrity (e.g. erosion, human intrusion) to a lesser degree or with a smaller probability, modelling periods of a few thousand years may still be reasonable."*



Note: IAEA's Safety Standards are not legally binding on Member States but may be adopted by them, at their discretion, for use in national regulations in respect of their own activities.

International Perspectives – United Kingdom

- Difficult to directly compare "compliance" times from other countries because of differing assumptions
- Low-Level Waste Repository in the United Kingdom
  - Dose constraint applies through closure, then risk guidance level
  - Probabilities for exposure scenarios for prospective calculations
  - Generally up to thousands of years considered - Reference case considered erosion of facility at 1000 years and 10,000 years considered for a delayed erosion case



2011 Environmental Safety Case (LLWR)

Other US Regulations

10 CFR Part 40, Appendix A, Criterion 6 (Tailings)

"A calculation of the potential peak annual TEDE within 1000 years to the average member of the critical group that would result from applying the radium standard (not including radon) on the site must be submitted for approval."

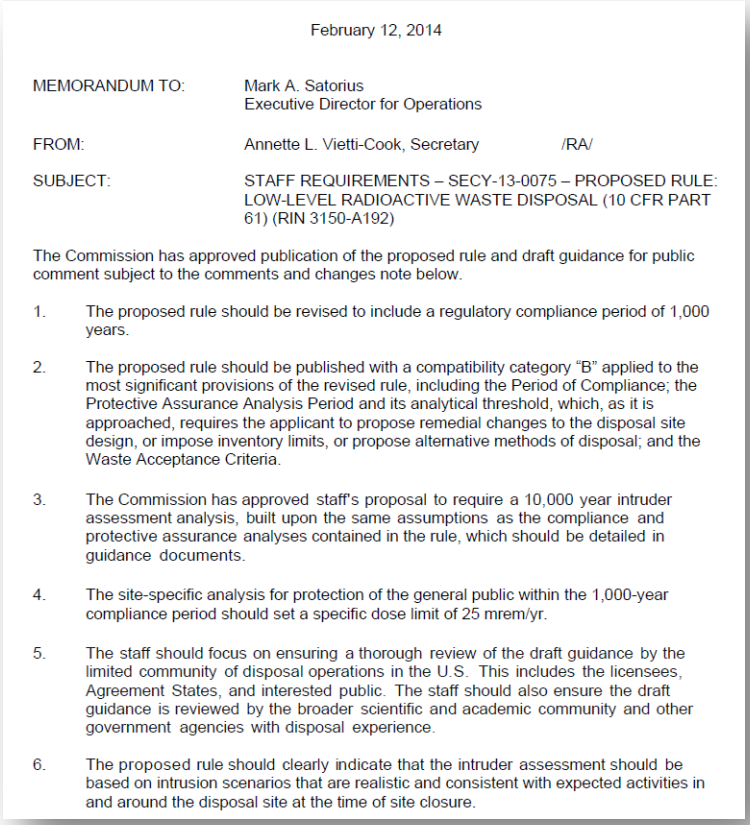
10 CFR Part 20.1401(d)

"When calculating TEDE to the average member of the critical group the licensee shall determine the peak annual TEDE dose expected within the first 1000 years after decommissioning."

NRC Direction Regarding Time of Compliance

Staff Requirements (SRM-SECY-13-0075) – Proposed Rule: Low-Level Radioactive Waste Disposal (10 CFR Part 61)

- "The proposed rule should be revised to include a regulatory compliance period of 1,000 years."
- "A further protective assurance analysis should be performed for the period from the end of the compliance period through 10,000 years."



February 12, 2014

MEMORANDUM TO: Mark A. Satorius
Executive Director for Operations

FROM: Annette L. Vietti-Cook, Secretary /RA/

SUBJECT: STAFF REQUIREMENTS – SECY-13-0075 – PROPOSED RULE: LOW-LEVEL RADIOACTIVE WASTE DISPOSAL (10 CFR PART 61) (RIN 3150-A192)

The Commission has approved publication of the proposed rule and draft guidance for public comment subject to the comments and changes note below.

1. The proposed rule should be revised to include a regulatory compliance period of 1,000 years.

2. The proposed rule should be published with a compatibility category "B" applied to the most significant provisions of the revised rule, including the Period of Compliance; the Protective Assurance Analysis Period and its analytical threshold, which, as it is approached, requires the applicant to propose remedial changes to the disposal site design, or impose inventory limits, or propose alternative methods of disposal; and the Waste Acceptance Criteria.

3. The Commission has approved staff's proposal to require a 10,000 year intruder assessment analysis, built upon the same assumptions as the compliance and protective assurance analyses contained in the rule, which should be detailed in guidance documents.

4. The site-specific analysis for protection of the general public within the 1,000-year compliance period should set a specific dose limit of 25 mrem/yr.

5. The staff should focus on ensuring a thorough review of the draft guidance by the limited community of disposal operations in the U.S. This includes the licensees, Agreement States, and interested public. The staff should also ensure the draft guidance is reviewed by the broader scientific and academic community and other government agencies with disposal experience.

6. The proposed rule should clearly indicate that the intruder assessment should be based on intrusion scenarios that are realistic and consistent with expected activities in and around the disposal site at the time of site closure.

Summary

- DOE has adopted a 1,000 year time frame for quantitative compliance and also addresses the potential for peaks after 1,000 years
- A number of policy and technical factors were considered, including:
  - Intergenerational equity and beneficial allocation of resources
  - Meaningfulness of results considering increasingly speculative and uncertain assumptions
  - International recommendations
  - Other promulgated rules involving near-surface disposal

Closing Summary

- DOE has a robust approach to oversight and implementation of near-surface disposal reflecting many years of experience
- Waste is managed on a site-specific basis in a risk-informed and performance-based manner
- Safe disposal is implemented using a defense in depth philosophy with combinations of physical and administrative safety features
- Looking forward, DOE is addressing future challenges related to disposal of waste streams such as:
  - Depleted Uranium
  - Greater than Class C LLW
  - Immobilized Low Activity Waste