UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, DC 20555 - 0001

ACNWR-0222

June 28, 2005

The Honorable Nils J. Diaz
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: DEFINITION OF A TIMESPAN OF REGULATORY COMPLIANCE FOR A GEOLOGICAL REPOSITORY AT YUCCA MOUNTAIN

Dear Chairman Diaz:

In a decision dated July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit ruled that the 10,000-year compliance period (hereafter the time period of compliance or TOC) specified by the U.S. Environmental Protection Agency (EPA) for its Yucca Mountain site-specific radiation standards at 40 CFR Part 197 violated Section 801 of the Energy Policy Act of 1992 (EnPA). It is unclear what changes will be made to Part 197 to address this ruling, but such changes will require the Commission to modify the regulations in 10 CFR Part 63. The Committee believes it may be useful for the Commission to consider previous ACNW advice on TOC, as well as other views on TOC.

BACKGROUND

Before 1992 the generic radiation standards and implementing regulations for evaluating geologic repository sites and licensing repository designs were given at 40 CFR Part 191 and 10 CFR Part 60. In 1992 Congress directed EPA and NRC to develop new radiation standards and NRC to develop implementing regulations for licensing of the Yucca Mountain site. In developing radiation standards, Congress directed EPA to contract with the National Academy of Sciences (NAS) to advise EPA on the appropriate technical basis for public health and safety standards for any Yucca Mountain repository.

On August 1, 1995, the NAS issued its report, “Technical Bases for Yucca Mountain Standards” (the TYMS report). The NAS concluded there was “no scientific basis for limiting the time period of the individual risk standard to 10,000 years or any other value.” According to the Academy, “compliance assessment is feasible for most physical and geologic aspects of repository performance on the time scale of the long-term stability of the fundamental geologic regime — a time scale that is on the order of one million years at Yucca Mountain.” The Academy also concluded that humans may not face peak radiation risks until tens to hundreds of thousands of years after the disposal of wastes, “or even farther into the future.” The Academy thus recommended “that compliance assessment be conducted for the time when the greatest risk occurs, within the limits imposed by the long-term stability of the geologic environment.”

After the Academy issued its findings and recommendations, EPA promulgated its draft Part 197 standards in which it proposed a 10,000-year TOC. In so doing, EPA requested comments on the reasonableness of adopting the NAS-recommended TOC or "some other approach in lieu of the 10,000-year compliance period," that EPA favored. During the public comment period, DOE and NRC went on record supporting the 10,000-year TOC while the State of Nevada proposed adopting a TOC extending to the time of projected peak dose, as NAS recommended. After reviewing the public comments, EPA promulgated its final rule adopting the 10,000-year TOC and in doing so expressed the view that NAS' TOC recommendation was "not practical for regulatory decision-making."

PAST ACNW ADVICE

The most recent ACNW views on TOC were given in two 1996 letters. The first letter gave background on defining a repository TOC, discussed related regulatory principles and selection criteria, and recommended a two-tiered approach to defining a TOC.[1] The second letter provided additional detail on the proposed two-tiered approach to addressing TOC issues.[2]

The first tier of the ACNW recommended approach was to define a quantitative dose limit for the reasonably maximally exposed individual (REMI) at a specific time for times on the order of several thousand years. The second tier was to qualitatively compare the peak dose and uncertainties of the dose standard. The Committee's recommendation did not require a quantitative measure of compliance at the TOC because of the uncertainties in defining future processes and events.

INTERNATIONAL APPROACHES

There is no international consensus on TOC among standard-setting bodies, regulators, and developers. This is not surprising considering the differences in national policies and the variations in design concepts and geologic settings. The attached table shows the variability of international TOC durations. Generally, a multitier approach to timeframes is used with a quantitative evaluation based on an early assessment of 1000 to 10,000 years and a longer, qualitative evaluation of a million years or longer, but there are many exceptions. Some countries, such as Germany, have not specified a TOC, but are considering the use of safety indicators with a qualitative assessment to a million years or more but no less than 10,000 years. Canada has specified a 10,000-year TOC and requires evaluation to an unspecified period beyond 10,000 years to show that there are no dramatic increases in dose in the post-TOC years.

Member countries of the International Atomic Energy Agency and the Nuclear Energy Agency (NEA) are participating in continuing activities to develop a consensus on using the results of performance assessments over long periods of time. Both organizations have recommended a tiered approach for evaluating repository performance. Deliberations on this issue continue. In the Fall of 2005, we expect to review a draft report on NEA's most recent workshop.

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[1] ACNW letter report dated June 7, 1996, "Time Span for Compliance of Proposed Yucca Mountain HLW Repository."

[2] ACNW letter report dated November 14, 1996, "Road Map to ACNW's Recommendation for TOC."

PATH FORWARD

Upon the release of EPA's draft rulemaking for public comment, the Committee plans to review the draft regulation, meet with the NRC staff and stakeholders, and report its observations and recommendations to the Commission. The Committee also anticipates being briefed on the results of a 2005 NEA workshop. The briefing will be useful in the NRC's effort to help develop an international consensus on the use of long-timeframe performance assessment results.

In addition, the ACNW plans to hold a working group meeting in the Fall of 2005 on technical issues associated with long-timeframe performance assessments at Yucca Mountain. The Committee will report to the Commission on the results of this working group meeting.

Sincerely,

/***RA***/

Michael T. Ryan
Chairman

Attachment:
As stated

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/RA/

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Chairman

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As stated

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OFFICE	ACNW	ACNW	ACNW	ACNW	ACNW
NAME	MLee	SSteele	MScott	AThadani	JTL for MTR
DATE	6/27/05	6/27/05	6/27/05	6/28/05	6/28/05

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ATTACHMENT

INTERNATIONAL APPROACHES TO DEFINING A REGULATORY TIME OF COMPLIANCE (TOC)

More than 30 countries have research and development programs for managing long-lived radioactive wastes in geologic repositories (Witherspoon and Bodvarsson, 2001[1]). Currently, there is no international consensus among standard-setting bodies, regulators, or developers in these countries on the time scale for evaluating the safety of geologic repositories. An effort is underway in the Nuclear Energy Agency to address this issue (by NEA's Integration Group for the Safety Case or IGSC). This Timescales Project has produced two reports so far. [2,3] A third "state-of-the-art report" is in preparation and will likely be published in 2006.[4]

The table below lists TOCs for 10 countries, including the United States, that have standards or guidance in place for evaluating the safety of long-lived radioactive waste repositories. A review of the literature indicates that several of these countries have TOCs that range from 1000 to 1,000,000 years. In some cases, there is no regulatory TOC cutoff and the calculations can be carried out to as long as 100 million years after facility closure. The technical bases for the specification of a particular TOC vary among developers and regulators. Cutoff times (i.e., the duration of the TOC) have been justified on the basis that (a) the relative hazard (toxicity) of spent nuclear fuel vs. a naturally occurring uranium ore body; (b) the potential for multiple peak doses to future receptors; and/or (c) intergenerational equity concerns. For the purposes of comparison, the table includes the three time frames selected by the International Atomic Energy Agency (IAEA) for an analysis of the use of repository safety indicators.

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[1] P.A. Witherspoon and G.S. Bodvarsson (eds.), "Geological Challenges in Radioactive Waste Disposal – Third Worldwide Review," Berkeley, Ernest Orlando Lawrence Berkeley National Laboratory, LBNL-49767, December 2001.

[2] Nuclear Energy Agency, "The Handling of Timescales in Assessing Post-Closure Safety of Deep Geological Repositories, Proceedings of April 16-18, 2002, Workshop, Paris, France, Paris, Nuclear Energy Agency/Organization for Economic Cooperation and Development, 2002. Also see Nuclear Energy Agency, "Integration Group for the Safety Case (IGSC) Workshop on Handling of Time Scales Assessing Post-Closure Safety – Compilation of Abstracts," Paris, Nuclear Energy Agency/Organization for Economic Cooperation and Development, NEA/RWM/IGSC(2002)6, June 2002.

[3] Nuclear Energy Agency, "The Handling of Timescales in Assessing Post-Closure Safety – Lessons Learnt from the April 2002 Workshop in Paris France," Paris, Nuclear Energy Agency/Organization for Economic Cooperation and Development, NEA No. 4435, 2004.

[4] Belgium proposed the Timescales Project to NEA's IGSC. The purpose of the project is to produce a "state-of-the-art" report to document a consensus for cutting off performance assessment calculations at a specific time, if possible. Belgian officials believe that it would be helpful to be able to cite an international report with a recommendation and a technical basis for the recommendation. Although the NEA document has not been drafted, a 1 million-year cutoff is beginning to emerge as an informal consensus TOC based on discussions among the participants.

A related concern is to use performance assessment results in accounting for the uncertainties of analyses. Performance assessments in timespans of less than 100,000 years are generally considered more reliable. Longer term assessments (TOCs greater than 100,000 years) are generally considered less reliable because the uncertainties increase with time.

Regardless of the length of the specified TOC, there is a consensus among practitioners that a multitier approach should be used to judge repository performance, as noted in the table below. Performance assessments of TOCs of less than 100,000 years are generally more quantitative and TOCs of more than 100,000 years are generally more qualitative.

Country	*TOC*	*Comments*
BELGIUM	**Not established yet**	Safety demonstration analyses for at least **100,000,000 years**. [a]
CANADA [b]	**. 10,000 years**	Demonstrate repository safety quantitatively with detailed calculations.
	< 100,000 years	Qualitative demonstration, using "reasoned arguments," that there is no dramatic increase in releases from repository after the first **10,000 years**.
	< 1,000,000 years [c]	An example for the purposes of the environmental impact statement to demonstrate that the radiological toxicity of spent fuel is equivalent to a natural uranium ore body.
FINLAND [d]	**. 10,000 years**	Evaluate repository performance over an environmentally predictable period.
	> 10,000 years	Do a stylized, quantitative calculation using a broad range of safety indicators.
	> 1,000,000 years	Do a qualitative calculation.
FRANCE [b, e]	**0–500 years** [f]	Do analysis for assumed period of passive institutional controls.
	< 50,000 years	Minimum period of environmental predictability. Analysis not intended to reflect future climate change and the onset of glaciation.
	> 50,000 years	Do a qualitative analysis as a reference, taking into account the expected evolution of repository system.
GERMANY	**No specified time**	Evaluate repository performance up to about **10,000 years**, taking into account period during which repository barriers would be subject to minor changes.[b]
		Do an analysis on the order of **1,000,000 years** to identify repository sites with overall favorable geologic characteristics. [e] Do other demonstration analyses for beyond **1,000,000 years.** [g]

Country	*TOC*	*Comments*
JAPAN [b]	**Not established yet**	Evaluate repository performance taking into account period of peak dose up to about **100,000,000 years**.[h]
SPAIN [i]	**Not established yet** (To be defined by 2010.)	Demonstration analysis to stop at **1,000,000 years**.
SWEDEN [j]	**< 1000 years**	Do a quantitative calculation.
	< 100,000 years[k]	Do a quantitative analysis, taking into account the next major glacial period. The analysis period must be greater than **10,000 years**.
	> 100,000 years	Do a stylized, qualitative calculation. The analysis is to stop at **1,000,000 years**.
SWITZERLAND [b]	**No specified time**	Duration for demonstration analysis terminated at **10,000,000 years**.[l]
UNITED KINGDOM [b]	**Not established yet**	Timeframe for analysis implied to be less than **1,000,000 years**.
UNITED STATES	**10,000 years** [m]	Timeframe for analysis for evaluation of transuranic (TRU) radioactive wastes.
	1,000,000 years[n, o]	Evaluate Yucca Mountain repository performance, taking into account periods of peak dose up to about **1,000,000 years**.
IAEA[p]	**< 10,000 years**	Quantitative analysis assuming the current biosphere and institutional controls.
	< 1,000,000 years	Mix of qualitative and quantitative "illustrative" calculations intended to reflect future climate change and the present-day reference biosphere
	> 1,000,000 years	Qualitative analysis during the period over which radiological toxicity of repository is equivalent to a natural uranium ore body.

REFERENCES:

[a] Studiecentrum voor Kernenergie – Centre ‹étude de µEnergie Nucléaire (SCK"CEN – Belgian Nuclear Research Centre), "Identifying and Testing Indicators for Assessing the Long Term Performance of Geological Disposal Systems: The [European] SPIN Project, *SCK'CEN Scientific Report 2002,* Mol, Belgium, [2002].

[b] U.S. General Accounting Office, "Nuclear Waste – Foreign Countries' Approaches to High-Level Waste Storage and Disposal," Washington, DC, Resources, Community and Economic Development Division, GAO/RCED-94-172, August 1994.

[c] Atomic Energy of Canada Limited, "Environmental Impact Statement on the Concept for Disposal of Canada's Nuclear Fuel Waste," Mississauga, Ontario, AECL-10711, COG-93-1, September 1994.

[d] The Radiation Protection and Nuclear Safety Authorities in Denmark, Finland, Iceland, Norway, and Sweden, "Disposal of High Level Radioactive Waste – Consideration of Some Basic Criteria," Stockholm, Sweden, Swedish Radiation Protection Institute (Statens Strålskyddsinstitut – SSI), 1993.

[e] Committee on a Site Selection Procedure for Repository Sites (Arbeitskreis Auswahlverfahren Englagerstandorte – AkEnd), "Site Selection Procedure for Repository Sites: Recommendations of the AkEnd," Berlin, German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety, December 2002.

[f] U.S. Environmental Protection Agency, "Spent Nuclear Fuel and High-Level Waste Programs Disposal Programs in Other Countries (Chapter 3) in Environmental Radiation Protection Standards for Yucca Mountain, Nevada – Draft Background Information Document for Proposed 40 CFR 197, "Office of Radiation and Indoor Air, EPA 402-R-99-008, August 1999.

[g] Bundesanstalt für Feowissenschaften und Rohstoffe, "Grundsätze der Endlagerung radioaktiver Abfälle – Die Sicherheitsphilosophie des Bundesamtes für Strahlenschutz (Standards for the Permanant Disposal Site for Radioactive Waste – Safety Philosophy of the Federal Office of Radiation Protection), Salzgitter, German Federal Republic, 2004.

[h] Japan Nuclear Cycle Development Institute [JNC], "H12: Project to Establish the Scientific and Technical Basis for HLW Disposal in Japan – Supporting Report 3: Safety Assessment of the Geological Disposal System," Ibaraki, Japan, Report TN1410 2000-004, 2000. [NOTE: Because of the current regulatory mandate to address international practices and standards, the Japanese are actively participating in the NEA Timescales Project.]

[i] A. Astudillo, "Geological Disposal of High-Level Radioactive Wastes in Spain," in P.A. Witherspoon and G.S. Bodvarsson (eds.) Geological Challenges in Radioactive Waste Disposal – Third Worldwide Review, Ernest Orlando Lawrence Berkeley National Laboratory, LBNL-49767, December 2001.

[j] Swedish Radiation Protection Institute, "Health, Environment and Nuclear Waste, SSI's Regulations and Comments," Stockholm, Sweden, SSI Report 99:22, 1999.

[k] Swedish Nuclear Power Inspectorate (Statens Kärnkraftinspektion), the repository developer whose implementing recommendations, including a time scale for the analysis, will be defended at the time of licensing.

[l] National Cooperative for Radioactive Waste (National Genossenschaft für die Lagerung radioaktiver Abfälle – Nagra), "Project Opalinus Clay: Safety Report – Demonstration of Disposal Feasibility for Spent Fuel, Vitrified High-Level Waste and Long-Lived Intermediate-Level Waste (*Entsorgungsnachweis*)," Wettingen, Switzerland, Nagra Technical Report NTB 02-05, 2002. (Although the demonstration calculations were

carried out to 10 million years, the Nagra report notes that there is little confidence in the calculations beyond 1 million years.)

[m] U.S. Environmental Protection Agency, "40 CFR Part 191: Environmental Standards for the Management of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Final Rule," *Federal Register*, Vol. 50, No. 182, pp. 38066-38089, September 19, 1985.

[n] National Research Council, "Technical Bases for Yucca Mountain Standards," Washington, DC, Commission on Geosciences, Environment, and Resources, National Academy Press, July 1995.

[o] U.S. Department of Energy, "Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, Vol. 1, Impact Analyses, Chapters 1 through 15, "Office of Civilian Radioactive Waste Management, DOE/EIS-0250, February 2002.

[p] International Atomic Energy Agency, "Safety Indicators in Different Time Frames for the Safety Assessment of Underground Radioactive Waste Repositories. First Report of the INWAC Subgroup on Principles and Criteria for Radioactive Waste Disposal," Vienna, Austria, IAEA-TECDOC-767, October 1994. (The NEA suggestion to evaluate until the dose from the spent fuel is equivalent to a uranium ore body would not likely require calculation beyond a million years.)