

Yucca Mountain – From 10,000 to 1-Million Year Compliance Period

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ABSTRACT

Two plus years ago a U.S. Federal Court of Appeals (the Court) ruled that EPA had not followed the recommendation of the National Academy of Science (NAS) with regard to the 10,000 year period of regulatory compliance. In response to that ruling EPA went back to the drawing board in 2005 and issued a draft rule that it believed complied with the Court's ruling and the intent of the NAS recommendation. The result is a recommendation to cause there to be compliance out to 1-million years.

It is the author's belief that thinking in terms of 1-million years is absurd, not based upon scientific information, and just results in yet another delay for an environmental program sorely needed by this country, especially in light of the nuclear power renaissance emerging at this time around the world.

So, the Yucca Mountain Project is at yet another critical juncture. It is facing a decision to either clear the political and regulatory issues and move ahead; continue to be stalled costing the nation billions of wasted dollars; or be moth balled until a solution is reached. The Department of Energy has announced that waste acceptance will be delayed until at least 2017 and it is hard to comprehend why the project should continue to be funded at current levels.

It is the author's opinion that only Congress can clear these obstacles so the project can move forward in a safe and efficient manner.

This paper will present the history of the ever increasing compliance period for Yucca Mountain; the need to reevaluate the regulatory strategy; the events that have occurred in the history of man and geologically in a million year time span; the absence of a mechanism for enforcing such regulations; the approach other countries are taking on this issue; the absurdity of trying to protecting people thousand of generations in the future from radiation doses that our generation is already exposed to from mostly natural causes, and lastly proposes a rational compliance period and regulatory strategy.

INTRODUCTION

“After some considerable research there is little certainty about the original proposal for using a 10,000 year compliance period for high level waste repositories in the United States. There are many statements in the literature citing policy makers in the 1970's and 80's considering 100 and 1,000 years too short and a million years too long. However, when NRC originally drafted licensing requirements for a geologic repository for spent fuel and high level waste in the 1980s as

10 CFR 60, it used a regulatory period of 1,000 years [1]. However, after many years of deliberation, EPA issued 40 CFR 191 in 1993, which, among other things, established the regulatory period at 10,000 years. As a consequence, NRC issued revised regulations which incorporated the EPA requirements. The main point here is that NRC had concluded that 1,000 year regulatory period was sufficient.

In 1996 Ray Clark of the Environmental Protection Agency (EPA) presented a review of the basis for 40 CFR Part 191 Disposal Standards [2]. His summary said that 10,000 years was selected because “many nuclides have reached [the] accessible environment, radionuclide hazard potential is descriptive of long times thereafter, changes in the geologic condition [are] changes [that are] expected to be small, [and] no major climate changes are expected in that time frame”. Mr. Clark further indicated that the EPA Science Advisory Board (1984) supported the 10,000 year regulatory period because among other reasons the overall performance of a repository is likely to be adequately understood at 10,000 years and there is poor confidence in longer projections. However, the Board did indicate that for site selection, releases and release effects should be checked at periods beyond 10,000 years. In 1987, the First Circuit Court of Appeals upheld the 10,000-year time frame. EPA promulgated the rule in 1993 long after passage of the Nuclear Waste Policy Act of 1982 and its 1987 Amendment [3].

In July 2004, the U.S. Federal Court of Appeals for the District of Columbia overrode that ruling, citing that, as required by the Energy Policy Act of 1992, EPA had not established a compliance period based on and consistent with the findings and recommendation of the NAS, and vacated the EPA and NRC regulations insofar as they include a 10,000 year compliance period. The 1995 NAS report “Technical Basis for Yucca Mountain Standards” recommended that assessments of compliance standards be conducted for the time at which the greatest risk occurs, and concluded there was no technical basis for selecting a shorter compliance period, such as 10,000 years. Although not specifically stated, a period of 1-million years was implied [4].

The NAS report focused upon “Geologic Stability” and implied that processes such as climate change, tectonics and earthquakes will occur as in the past, and that changes will be boundable. As early as 1995 the 10,000 year period came into question by an NAS panel led by Robert Fri. The panel recommended to EPA that it use long term probabilistic models for assessing radioactive plume transport for a period of at least the likely peak dose [4]. In light of this panel’s views, the DOE has conducted performance assessments that go out to and beyond the period of likely peak dose (hundreds of thousands of years based on certain assumptions).

The following is a summary of how time frames are characterized for performance assessment modeling.

- 100 to 1,000 years -- the repository is characterized by intact waste canisters and relatively high temperatures that drive water away from the waste.
- 1,000 to 10,000 years -- Canisters begin to corrode as temperatures diminish, water enters the repository, the engineered features of the repository start to degrade and minor releases of radioactive materials begin. Doses are dominated by Tc-99 and I-129

- 10,000 to 1-million years -- Canisters disappear over time, water seeps through the repository and transports diluted mobilizable radionuclides to the accessible environment. Doses are dominated by Np-237.

The International Atomic Energy Agency draft Safety Requirements No. WS-R-4 states “It is recognized that radiation doses to people in the future can only be estimated and the uncertainties associated with these estimates will increase for time farther in the future [5]. Care has to be exercised in applying the criteria for periods beyond the time where the uncertainties become so large that the criteria may no longer serve as a reasonable basis for decision making.” It further states that “The dose limit for members of the public from all practices is an effective dose of 1 mSv (100 mrem) in a year, and this or its risk equivalent is considered a criterion not to be exceeded in the future. To comply with this dose limit, a geologic disposal facility (considered a single source) is designed so that the estimated average dose or average risk to members of the public who may be exposed in the future as a result of activities involving the disposal facility does not exceed a dose restraint of 0.3mSv (30 mrem) in a year or a risk constraint of the order of 10^{-5} per year (applied to geologic repositories). It is recognized that radiation doses to individuals in the future can only be estimated and that the uncertainties associated with these estimates will increase for times farther in the future.” No criteria were stated in the report for a specific period of compliance.” [6] These Safety Requirements are under review by IAEA.

OBJECTIVE

The objective of this paper is to examine the validity and reasonableness of regulating Yucca Mountain or any other human endeavor out to 1-million years.

ANALYSIS

In a paper presented in 2005 at the Annual Meeting of the Institute of Nuclear Materials Management, Mr Edway R Johnson and I concluded that a 10,000 year compliance period was actually beyond the realm of realistic regulation and engineering and that EPA should

- “Require that the design of the repository have a reasonable chance of success in resulting in a maximum dose of 15 mrem/year to the maximally exposed individual through 3000 years following disposal, based on the assumption that engineered containment of radionuclides will be successful in totally sequestering them for at least 1,000 years. This should allay any concerns that discounting of health effects would have an adverse affect on public safety in the near term (i.e., 3,000 years), because health effects would not be discounted during this period.
- After 3,000 years, health effects should be discounted. Since any discount rate greater than 0.2%/year results in essentially no health effects, consideration probably shouldn’t be given to any target for discounted exposure of the maximally exposed individual after 3,000 years following disposal.” [6]

But by attempting to meet the Federal Court and National Academy of Science requirements, EPA has moved in an opposite direction by proposing a rule that would in fact regulate Yucca Mountain so that “Compliance will be judged against a standard of 150 microsievert per year (15 millirem per

year) committed effective dose equivalent at times up to 10,000 years after disposal and against a standard of 3.5 millisievert per year (350 millirem per year) committed at times after 10,000 years and up to 1 million years after disposal”.[7] Public comments were sought until November of 2005. As of the writing of this paper the status of the proposed rule remained unchanged.

The author offered the following electronic comment to EPA on August 15, 2005. *The EPA is to be complimented on acting to reassess the 10,000 year standard, and bringing it to the public for comment. However, it is unthinkable that humans can begin to deal in terms of even 10,000 years, let alone 1-million years of regulation. The standard established in the 1980's and confirmed by courts in the 1990's was more than sufficient to protect the public health and welfare. A period of compliance of 3,000 years would be more in keeping with a reasonable time that engineers and scientists can predict performance and design facilities. And the level of radiation would have reduced to very low levels by that time. Also, the performance assessment calculations by DOE are based upon conservative assumptions, so the levels of radiation that would actually be emitted from the repository would be very low. The law should protect the public by requiring retrieval for periods of hundred of years, in case future generations wish to reverse our decisions or the resource becomes valuable. Please do not propose rules that do not pass the reasonable test just because of social and political pressure. Thank you for your consideration.* As of January 2006 there had been more than 2500 comments submitted, according to Ms. Bonnie Gitlin of EPA.

The Swedish Protection Institute provided draft regulations (Guidance to SSI FS 98:1) in which it proposed two time frames: a thousand years for quantitative risk analysis and hundreds of thousands of years based on a stylized description of future cycles of major climatic changes. The latter was intended to shed light on the protective capacity of the repository and to provide a qualitative picture of risks. They concluded that “the risk analysis should at least cover approximately one hundred thousand years or the period of a glaciation cycle to shed light on the reasonably foreseen strains on the repository”.

Let us consider a time 9,999 years after waste emplacement at Yucca Mountain. A measurement of 16 mrem per year is recorded at a well adjacent to the boundary of the project. What recourse will the public have to cure the problem? Will the waste be taken from the mountain after the waste packages have likely been seriously degraded? Or will the government buy up the land or deliver water to the residents? How could such a regulation be enforced? Will the next ice age be upon them? What will society be at that time, and will this really be a major issue for them to deal with, or will global warming have caused them to move to another planet?



Figure 1
10,000 Year perspective (DOE)

Over the past hundreds of thousands of years the earth has seen a number of geologic changes that may affect the climate and conditions at Yucca Mountain. That time frame has seen glaciation, volcanism and seismic activity. So if the regulation is to be based upon a period of geologic stability, it may be a period much less than hundreds of thousands of years. But the bottom line is that we are dealing with events that cannot be predicted with any certainty, and that should not be the basis for these regulations.



Sources: www.anthro.palomar.edu/homo and www.encyclopedia.com

Figure 2
Million year perspective (EPA) [14]

Current dose standards for Yucca Mountain are very conservative and not based upon health risks. For example the 15 mrem per year limit at Yucca Mountain is equivalent to about one chest X-ray. The radiation levels experienced by most Coloradoan, where I live, is about 700 mrem per year. [6] [12] Dose levels also need to be reconsidered.

CONCLUSIONS AND RECOMMENDATIONS

- Any form of regulation that extends beyond the realm of human and geologic understanding is unreasonable and our nation needs to assess the reality of what to do with high level waste in a manner that passes the rationality test. Considering the changes in technology and society over the last 100-years it is absurd to predict thousands of years into the future.
- The consideration of time periods beyond thousands of years should be to inform the public of the risk in those time frames, but not be regulatory in nature.
- Congress should act to specifically prescribe the compliance period, as suggested by the Court. In my opinion if the outstanding issues are not resolved quickly, the Yucca Mountain repository project should be suspended until the nation's approach to the ultimate disposition of high level nuclear waste is resolved. The expenditure of tax and rate payer dollars is not advancing the project to any measurable degree.

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