

Are We Serious in the US about the Disposal of HLW? - 13561

Robert H. Neill

Director Emeritus, New Mexico Environmental Evaluation Group (EEG),
9409 Thornton Ave., N.E., Albuquerque, New Mexico 87109, USA-(E:
righters@highfiber.com)

ABSTRACT

Since all efforts to date to dispose of HLW in the US have been unsuccessful, the following specific actions need to be taken if we are serious about such disposal:

- The requirement in the EPA environmental radiation protection standards to predict the behavior of these unwanted residuals for one million years is meaningless. The Standards must be revisited.
- Characterize two sites. There are myriad ways a site can be found to be unacceptable. Additionally, the existing HLW inventory requires a second repository.
- Congress should specify incentives to states under consideration for a site. Perhaps 5% of total cost would be appropriate.
- An independent technical review group should be established in such states to evaluate a proposed repository similar to the New Mexico Environmental Evaluation Group (EEG) for the WIPP Project because the state's interests are not necessarily the same as DOE's.
- Acceptance or rejection of a proposed site should be based on technical issues, not social ones. Professionals in this field should present papers identifying the merits of HLW disposal in their own state. The scarcity of such research suggests Not In My Back Yard (NIMBY) syndrome.
- Medical diagnostic ionizing radiation exposure to the US public is now 8,000 times greater than radiation exposure from nuclear energy. People accept this believing the benefits outweigh any risks. A major effort needs to focus on both benefits as well as risks of radioactive waste disposal.
- DOE needs to announce preferences of host rock formations, incentives for states, and potential consequences should we fail to act.

INTRODUCTION

Although over \$22 Billion has been spent in the past 55 years to dispose of HLW and SNF, all efforts to date have proven to be unsuccessful. (As used here, HLW means SNF and HLW from both commercial and defense activities). Rather than argue about the causes and the guilty culprits, it is more productive to identify actions to resolve this seemingly intractable problem.

In January 2012, the Blue Ribbon Commission on America's Nuclear Future (BRC) published an excellent report [1] with specific recommendations to deal with the problem of disposal of HLW. This paper reinforces the BRC recommendations and urges a number of actions be undertaken now because a year has elapsed since the BRC issued its report.

While most people agree that we need to permanently deal with the resulting unwanted radioactive residual waste products, there is still disagreement on how to do so although the first reactor went critical in Chicago 70 years ago. The following failures illustrate how important it is to finally solve the problem.

- Reprocessing of SNF to reclaim unused fissionable material. Encouraging this could cause international proliferation problems. Besides, there still would be radioactive waste after reprocessing. Hence it is not a viable option for the foreseeable future.
- Screening sites on basis of lists of criteria. Ranking of sites based on desirable characteristics, such as nearness to mining resources, ground water, adjacent deep boreholes, etc. was used in the US in the 1980s to winnow lists from 5 to 3 then to 1 disposal site. This did not work. We would not go about selecting a spouse by writing down a list of preferable characteristics and then narrowing the list of potential spouses to make a selection. Selecting a repository site is an equally serious business.
- Appointing a Negotiator in 1987 to convince a state to accept a repository. David Leroy worked hard to do this, but individual states did not wish to be singled out as receptive any more than a state Governor would wish to publicly volunteer to accept all the Nation's conventional garbage.
- Congress wisely avoided self-regulation by DOE by assigning the authority to determine the radiological safety of a proposed repository to the regulatory agencies, EPA and NRC. Site specific standards were eventually issued by EPA, the DOE submitted a license application to NRC for the construction of a HLW repository in Nevada in 2008 but a year later the process was terminated before NRC could make any determination. It is ironic that the Administration and the Congress, who set up a system under the 1982 NWPA [2] to evaluate a repository based on technical evaluation, abandoned the system to make a decision largely as a non-technical determination.
- Crystalline rock formations in the eastern US were under investigation for a second repository in the 1980s. After heavy political opposition developed in those states being considered, Congress [3] canceled further consideration.

DISCUSSION

Time Period for Evaluation

Standards [4] issued by EPA in 1985 for the safe disposal of radioactive transuranic (TRU) waste, SNF and HLW required DOE to estimate their behavior for 10,000 years. Subsequently, EPA promulgated site-specific standards for the Yucca Mountain (YM) site in Nevada for SNF and HLW disposal [5] which require predicting their behavior for one million years. How did this come about? After some criticism of the ten thousand year period as excessive, Congress assigned the responsibility to the National Academy of Sciences (NAS) to establish a more defensible period of time. The NAS recommended one million years as an appropriate period to

limit releases and the law required EPA to incorporate the NAS recommendations into their YM Standards.

Radiation exposure to people can occur via two mechanisms, inhalation and ingestion. For the former, one must estimate the fraction of specific radionuclides less than 10 microns in particle size released to the biosphere and subsequently resuspended in air in order to calculate radiation inhalation doses. As an indication of the difficulty of predictions over 100,000 decades, measured and predicted concentrations of radon gas emanating from a uranium mill tailings pile [6] varied by two orders of magnitude after only two decades. Data presented at an international symposium on transuranics in the environment in 1975 showed a range of 10 in environmental plutonium measured in samples of water, plankton and fish. (Page 13) Additionally, concentration factors varied by a factor of 4 (page14). [7] Therefore, calculations over a much longer time period are of little value due to the uncertainties in the predictions. For ingestion, predicting man's diet for a million years is similarly meaningless. The regulations assume no advancement in advancement in medical knowledge or changes in social or political norms. The Standards, which are site specific for YMP, need to be generic to avoid the need to write new standards for each site being investigated. Hence, the Standards must be revisited.

A major difference in a repository for HLW from one for TRU waste is the fission products in the former generate considerable heat. Several thousand years after disposal most of the fission products and induced radioactivity will have undergone radioactive decay leaving the long- lived alpha- emitting actinides in the inventory and the HLW becomes similar to a TRU repository.

The most hazardous radionuclide at WIPP, which is a facility for the disposal of transuranic radionuclides from the Nation's defense programs, is considered to be Pu-239 with a 24,300 year (y) half-life. Other radioisotopes of plutonium have either shorter half- lives, are beta- emitters [11] or the quantities are much smaller.[10], Vol II , Table 14, p G-28 and Table G-15, p G-29. The total estimated inventory of Pu-239 at WIPP is 2.94×10^{16} Becquerel (Bq) (7.95×10^5 Curies [Ci]) which amounts to 13 MT. [8] The DOE Final Environmental Impact Statement for YM estimates there would be 9.2×10^{17} Bq (2.48×10^7 Ci) (404 MT) of Pu-239 plus one million Ci (16 MT) of surplus plutonium from the Nation's weapons programs [10] . Hence there would be about 420 MT / 13 MT or about 32 times more Pu-239 in a HLW repository than in WIPP. Other differences beside the considerable heat generated by the SNF and HLW include the much larger radionuclide inventory and the presence of some less hazardous long lived fission products such as the beta- emitting I-129 (1.7×10^7 y half- life) and Cs-135 (2.1×10^6 y half- life).

In 10,000 years Pu-239 with a 24,300 y half- life will have decayed to 0.752 of its initial activity. In one million years, Pu-239 in a HLW repository it will have decayed to 4.1×10^{-13} of the original value of 25×10^6 Ci. At one million years the HLW Pu-239 inventory would have decayed to a mere 3.7×10^5 Bq ($10 \mu\text{Ci}$); a needlessly restrictive reduction.

Note that a bucket of lead is as hazardous today as it was one million years ago. Society does not require estimates in perpetuity of the toxicity of releases from repositories of lead batteries.

Characterize Two Sites

Several sites in various geological media have been selected only to subsequently find out they were not suitable for various reasons such as Lyons, Kansas for TRU waste, HLW in Yucca Mountain in Nevada, Deaf Smith County in Texas, Hanford Reservation in Washington and three large regions with crystalline rock formations in the eastern US. There are myriad ways a site can be found to be unacceptable and the Nation cannot afford to restart the clock several decades from now. Take a fresh look at crystalline rock, basalt, and bedded salt. Stated simply, “Don’t put all your eggs in one basket.”

The US now has more HLW requiring disposal than the authorized capacity for the first repository and is continuing to generate at least 2000 MTU more each year. The proposed inventory for the first repository should be considered to be an upper limit for the first repository because increasing the authorized capacity of the repository after Congressional authorization by increasing the amounts to be disposed did not sit well with many people in Nevada. Hence, characterizing two sites provides the Nation with a double benefit—a backup for the first and a home for the second.

Actions by Congress

In 1982 Congress wisely established a system for HLW disposal assigning specific responsibilities to DOE, EPA and NRC. After DOE submitted an application to NRC in 2009 to begin construction of YM as a repository, in 2010 the White House, with the consent of Congressional leadership, canceled the effort and abandoned the system that had been established. Today, there are no plans to develop a repository for HLW. Congress and the Administration need to agree on a system and stick with it. Congress should not be asked to solve technical problems such as the time period to limit releases.

Independent State Evaluation

It is essential to have an independent technical state group consisting of knowledgeable professionals in the field of radiological health (health physics), geology, hydrology, modeling and chemical engineering since the interests of a state are not necessarily similar to those of the proponent, DOE. In New Mexico, the Environmental Evaluation Group (EEG) provided that expertise for the WIPP Project. EEG published over 80 technical reports including those on site evaluation, applicable standards, modeling, waste characterization, transportation and monitoring of radioactivity. It is a source of enormous pride that the co-author of four EEG reports on the design of the 655 m (2150ft) waste handling hoist, Professor Thomas Sargent, New York University, received the Nobel Prize in Economics last year. His reputation for the rigor of his mathematical modeling has been well recognized.

Technical Community

Engineers and scientists employed by contractors in this field should be encouraged to present papers at national meetings showing the merits of disposing HLW in their home state that have been generated from defense and commercial activities in other states. The paucity of such

research has been construed by anti-nuclear activists as a form of NIMBYism (Not in My Back Yard) by the technical community. We need to take actions to avoid such charges. It is essential that the public have full confidence in the work and conclusions of the technical community to determine whether a proposed repository should be accepted or rejected. Such actions must be based on technical issues, not determined by social ones.

Benefits as Well as Risks

By 2009, the total population radiation exposure in the US from nuclear energy was estimated to have decreased 80% in two decades to 110 Person-Sieverts. During the same period, the medical diagnostic ionizing radiation exposure increased by a factor of 7.3 to 899,000 Person-Sieverts, a factor of 8,000 greater! [12] The public appears to have accepted this astonishing increase in the belief that the benefits from this radiation clearly outweigh any risks. For nuclear energy exposure, many people focus solely on the risks and not the benefits.

The use of ionizing radiation to preserve perishable foods in developing nations has been shown to cost a dollar a day to save a life from starvation. Cost analyses of standards for radiation protection indicate we may be spending millions of dollars to save a life. Benefits, as well as risks, need to be discussed in public forums with elected officials and the technical community.

Public acceptance of activities in defense of our country have always had a higher acceptability by the public such as defense TRU waste at WIPP and nuclear weapons testing at the Nevada Test Site in comparison to the problem of the disposal of commercial HLW.

DOE's Responsibilities

Currently there appears to be a vacuum in any announced plans to develop a HLW repository. In the absence of the recommended actions laid out by the BRC in January 2012, as a minimum DOE needs to issue a definitive paper identifying the extent of the problem, potential rock formations, financial and other incentives for states under consideration, estimated costs, the status of funds collected from ratepayers for electricity from nuclear power reactors, etc. It should also include an analysis of the consequences should we continue to fail to act.

Although DOE was required to develop plans for a second repository, it was decided that the easier course of action was to increase the design capacity of the first one. While this was logical, we no longer have a first one. As a result we now have more HLW to dispose from defense and commercial activities than the authorized capacity of the first now nonexistent repository—and are continuing to generate more. So characterizing two sites not only provides backup for the first---but starts the nation on the road for the needed second repository

RECOMMENDATIONS

The YM Standards requiring predictions of the behavior of HLW disposed in a repository for one million years are meaningless. They must be revisited and also changed to generic rather than site-specific.

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Characterize two sites. There are myriad ways a site can be found to be unacceptable. The old axiom applies, “Don’t put all your eggs in one basket”. Furthermore, the Nation needs to begin work on a second repository.

Congress and the Administration need to decide on a formal system to develop a HLW repository and then stick to it.

A technical state evaluation organization is required for public confidence.

Benefits as well as risks need to be clearly identified to the public, the technical community and elected officials.

Because a year has elapsed since the BRC issued its report, DOE needs to start by issuing a definitive white paper on the needed system.

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