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Some Unlearned Lessons in Radioactive Waste Disposal

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ABSTRACT

Various radioactive wastes have been successfully disposed and the benefits of those actions clearly outweigh the risks. However, progress in the disposal of unwanted radioactive residuals has been slow, expensive and frequently subject to economically unreasonable demands. While many impediments to the safe disposal of radioactive waste are beyond the direct influence of the technical community, some actions taken in the past have produced problems that are avoidable. This paper discusses the importance of resolving technical problems rather than seeking legislative solutions, prompt resolution of interagency disputes, of providing a perspective to the substantial increase in medical diagnostic radiation exposure to the American public, and the need to provide analyses on the benefits of the disposal of radioactive waste as well as the risks.

INTRODUCTION

Society has concluded that the generation enjoying the benefits of various nuclear materials should also assume the responsibility and risks of their disposal.

The fundamental philosophy of the radiation protection community is the prevention of unnecessary radiation exposure. The key here is the word “unnecessary” and who makes the determination. While that responsibility has been assigned by Congress to the regulatory agencies, those responsibilities are also shared with the disposal agency, the technical community, the Congress, and the public.

PRACTICES CAUSING PROBLEMS

The following identifies practices that have resulted in delays, increased costs, unfulfilled objectives and are preventable for future needs for radioactive waste disposal.

A. Changes in radioactive waste disposal practices

While it is normal that disposal practices change over time, some of the following practices were changed without valid technical reasons for political and socioeconomic reasons.

- High Level Waste. Funding for the Yucca Mountain Project (YMP) was largely discontinued in 2009 and the approval process established by Congress assigning specific roles to EPA, NRC and DOE seemingly abandoned. [1]. DOE had submitted an application to NRC in June 2008 which was expected to take 4 years to process.
- In 1982 Congress required DOE to evaluate the need for a second High Level Waste repository and report no later than Jan 1, 2010. [2]. DOE's response was that it was more logical to increase the limits on HLW at Yucca Mountain (YMP) and not pursue the uncertain course of legislation for a second repository. While this was reasonable, the cancellation of funding for YMP leaves us without a clear path for a proposed repository for HLW disposal.
- Monitored Retrievable Storage. The 1982 Nuclear Waste Policy Act required DOE to develop an MRS. The plan was put on hold in 1987 and a Negotiator appointed to develop one.[3]. By 1994 the plan was abandoned at a number of different sites due to strong local opposition.
- Radioactive waste with concentrations from 10 to 100 nCi/g are processed as TRU waste by emplacing 9 drums with concentrations less than 100 nCi/g with one drum of TRU waste with a concentration of 16,000 nCi/g making the average container concentration greater than 100 nCi/g. [4] (Note that 1nCi = 37 Bq). It is more expensive to dispose of these non TRU waste materials as TRU waste.
- Transuranic Waste Shallow Disposal was discontinued in 1970 for deep geologic disposal [5] however some TRU waste will be left in shallow burial.
- Intermediate Level Waste in open pits and covered trenches at ORNL. Discontinued in 1962 when ruthenium migrated to surrounding streams.[6]
- Deep Ocean Disposal. Discontinued when vertical mixing was recognized and subsequently prevented by the London Convention of 1972 [7]
- Shallow Ocean Disposal. Discontinued when Cs-137 leached from drums, taken up by plankton, consumed by fish and then eaten by man and banned by 1993 Amendments to the London Convention of1972. [7]
- Uranium mill tailings used as foundation materials for schools and other buildings, Discontinued with recognition that radiation doses were not trivial. In 1960 NCRP, FRC and ICRP recommended limiting general population whole body doses to 0.005 Sv/year and lung doses to 0.015 Sv/year, [8]
- Liquid waste forms were discontinued due to leakage from containers.

The net upshot is that it appears we change our minds all too often raising public concerns of the long term validity of our actions. We must carefully select the desired option for a specific waste form, plan thoroughly, and embark on a course of action.

B. <u>Regulatory Standards</u>

1. Some delays in implementing the high level waste standards were caused by an impasse in jurisdictional authorities between NRC and EPA. [9] After Congress required EPA to

incorporate recommendations from the NAS for the time period to evaluate a repository, EPA published a final rule in Sept 2008 and in Feb 2009 NRC announced they would approve the incorporation of the EPA Standards into their regulations.[10]. Meanwhile DOE earlier submitted their application to NRC in June 2008. Needless to say, one cannot make a determination of the suitability for disposal without a yardstick to measure the performance. The point to be made here is not to examine the relative merits of the arguments of either agency, but the result of the delay of several years in cost and timeliness in implementing the standards.

2. When various groups were concerned over the difficulty to show compliance with the 10,000 year containment requirement of EPA for HLW disposal, Congress assigned the authority to determine the reasonableness of the time period to the National Academy of Sciences who concluded that analyses should not be for 10,000 years but could extend to one million years. My personal belief is that calculations of internal radiation doses from the ingestion of food and water and inhalation of resuspended particulates are meaningless over such a long time period.

C. Risk Comparisons

1. The risks from potential exposure of high level wastes are trivial when compared to the 420,000 annual deaths from cigarette smoking. While that fact is intended to provide a perspective on the relative risk of radiation exposure, it is all too frequently presented as justification of the activity. We need to be very careful how we present relative risks.

2. Voluntary and Involuntary Risk. As a parent, one can let your son play tackle football in high school. On any Monday half the team is black and blue and there may be sprained ankles and a broken wrist for this voluntary risk. But if the entire student body were in similar shape from the compulsory (involuntary) physical education program, as a parent you wouldn't put up with it for five minutes. Hence people understand differences between voluntary and involuntary risks.

Comparisons of voluntary risks for adult workers paid for 40 hours per week to involuntary risks from the same facility to nearby residents of all ages for 168 hours/week are similarly improper. There is a different acceptance level for voluntary risks and involuntary risks.

3. Medical Radiation Risk. Diagnostic radiation exposure is much larger than any potential radiation exposure from the disposal of radioactive waste. A 2009 Report by the NCRP indicates that medical radiation exposure has increased by a factor of 7.3 from123,000 person-Sv in the early the 1980s to 899,000 person–Sv in 2006 and now accounts for almost half the total radiation exposure to the US population. This astonishing increase is attributed to CT scans and nuclear medicine. It is interesting to note that the public accepts the increase in medical radiation exposure since the benefits of better non-invasive diagnostic information obtained earlier are believed to outweigh any risks.

4. NCRP 160 also notes that the annual collective effective dose from US nuclear power operations had decreased from 565 person-Sv in the early 1980's to 110 perso –Sv in 2006 (0.3% to 0.1%) during the same period that the generation of electricity from nuclear power reactors increased. Schauer and Linton note in their discussion of NCRP160 in the Health

Physics Journal [12] that professionals in radiation protection could apply their expertise on nuclear power plant operations to reducing unnecessary medical radiation exposure; This is a useful area to pursue in reducing unnecessary radiation exposure of the general population. The American College of Radiology and the World Health Organization have embarked on programs to reduce the unproductive use of medical diagnostic radiation exposure.

5. Probabilistic Risk Analyses. The public has an intuitive understanding of probabilistic risks. A large meteor striking a high school could kill the entire student body but is unlikely to happen in comparison to a student being beaten up in the parking lot. And that is why we have policeman assigned to high schools rather than astronomers. PRA should be used more widely than deterministic analyses.

We also need to identify the benefits of radioactive waste disposal as clearly as we provide information of the risks.

D.Congressional Solutions to Technical Problems

1. We have already addressed the HLW million year period of compliance.

2. When DOE wished to bring TRU waste to WIPP before submitting an application to EPA for certification, Congress agreed that it would be useful to conduct experiments with waste at WIPP to obtain data useful in showing compliance with the standards. Congress then required DOE to conduct such tests before bringing TRU waste for disposal. The proposed experiments were completely without merit and DOE then canceled plans to conduct them. But the law required waste to be brought for experiments before bringing waste for disposal. Hence, the law had to be changed to delete that requirement in order to dispose of TRU waste. Moral: Don't pursue legislative solutions or go to Congress to solve technical problems. That is our job.

E. Funding for HLW disposal

We have collected over $22 Billion from the ratepayers for the disposal of spent fuel which is no longer available having been used to reduce the deficit. We have spent over $10 Billion at the Yucca Mountain Project for HLW disposal. The quantity of spent fuel now requiring disposal exceeds the projected capacity of YMP. And we may no longer have that facility to dispose of these wastes. Although the 1982 Nuclear Waste Policy Act required planning for a second repository if needed, we have chosen to request an increase in capacity of the first—which may no longer be viable. An aggressive program addressing sociological and economic issues as well as technical ones should be vigorously pursued now for HLW disposal.

F. General While we agree we can technologically store spent fuel for many decades in retrievable storage, I personally believe we must begin rational planning now for a permanent solution to this problem of HLW disposal or the needed nuclear power plants will not be acceptable to a large fraction of our population. It may appear to be a Sisyphean task, but only if we make it so by failing to resolve these substantive challenges.

RECOMMENDATIONS

a. Unless there are compelling technical reasons to abandon a proposed method of waste disposal, stick to the game plan to avoid erosion of public confidence.
b. Jurisdictional disputes between regulatory agencies should be promptly resolved to avoid needless delays in establishing standards necessary to measure whether the facility is acceptable or not.
c. Don't go to Congress to get standards changed. Either convince the regulatory agency why the requirement is improper or change the design to meet the standard.
d. Use risk analyses properly and do not use them to justify a course of action. It is vital to concurrently do benefit analyses. Diagnostic medical radiation exposure has increased by a factor of 7.3 in two decades and is generally acceptable because the public believes the benefits outweigh the risks.
e. Over $20 Billion in funds collected for the HLW program have been used to lower the deficit. It will be increasingly difficult to obtain funds for a future repository and we need to be both focused and frugal in our required needs.
f. Political solutions are always a mixture of technical, social, and economic considerations. The technical community in the field of radioactive waste has a responsibility to help resolve these problems.

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