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**DOCKETED
USNRC**

April 4, 2008

April 5, 2008 (10:30am)

Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Rulemakings and Adjudications Staff

**OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF**

Re: Comments to 37 <u>Fed. Reg.</u> 3812
      <u>RIN 3150-AH45</u>

Dear Secretary:

The State of New Jersey is hereby submitting comments to the NRC's rule proposal at 37 <u>Fed. Reg.</u> 3812, 3836 (January 22, 2008) (proposed codification at 10 <u>C.F.R.</u> 20.1403(c)(1)), which proposes a constant 1% real interest rate to be assumed in determining the required financial assurance to care for and maintain sites decommissioned for restricted use.

With the issuance of the Long Term Control ("LTC") license in NUREG-1757 Rev. 1, the NRC has changed its policy to make it easier for facilities to conduct onsite disposals of their long-lived radioactive waste upon decommissioning. The LTC license allows a private entity to own and be responsible for controlling

and maintaining the long-lived radioactive waste site in lieu of government ownership of the site. No private entity can be expected to endure for the thousands, millions, or billions of years that long-lived radioactive waste remains a hazard. Under these circumstances, the financial assurance is even more important since it provides the only remaining means for a third-party to become the LTC licensee and have the financial resources to properly control and maintain the site in a manner which protects the public health and environment after the original LTC licensee goes out of business.

Because long-lived radioactive waste sites require financial assurance to endure for the thousands, millions, or billions of years that the waste remains a hazard, the NRC erred in only considering the interest rates during a single thirty-year period between 1975-2005 in determining the proper investment rate. 37 Fed. Reg. at 3824. When considering the past 200 years, one finds that interest rates are highly variable and therefore uncertain. See, e.g., S. Homer and R. Sylla, A History of Interest Rates (4th Ed. 2005). The future interest rate is also uncertain because it depends on "the rate of economic growth, the amount of capital that will be accumulated, the degree of diminishing returns, the state of the environment, the state of international relations, the level and pace of technological progress, the rate

of pure time preference, the degree of substitutability of accumulable for nonaccumulable factors, and all of the many other economic and noneconomic features that might be relevant to determining the distant-future own rate of return on consumption." M. L. Weitzman, "Why the Far-Distant Future Should Be Discounted at its Lowest Possible Rate," 36 J. of Envtl. Econs. & Mgmt. 201, 203 (1998). Because of the uncertainty of predicting future interest rates, the NRC should incorporate this uncertainty into its methodology by using a declining investment rate. See M. L. Weitzman, "Gamma Discounting," 91 The Am. Econ. Rev. 260, 261 (March 2003). The constant 1% real investment rate proposed by the NRC does not take into account the uncertainty in interest rates. Thus a constant 1% real investment rate assuming that interest will consistently compound into perpetuity is unrealistic. Weitzman, 36 J. of Envtl. Econs. & Mgmt. at 203-207; Weitzman, 91 The Am. Econ. Rev. at 270. The general view among economists is that a declining discount rate should be used in conducting a long-term cost benefit analysis. H. Neill and R. Neill, Perspectives on Radioactive Waste Disposal: A Consideration of Economic Efficiency & Intergenerational Equity page 6 (WM'03 Conference, February 23-27, 2003).

Although these articles concern the appropriateness of a declining discount rate for long-term cost-benefit analyses, they

are still applicable to this case where the NRC is determining the appropriate investment rate to be assumed when determining the amount of financial assurance that should be posted for long-lived radioactive waste sites. Determining the appropriate investment rate for financial assurance used for long-term care is essentially a cost-benefit analysis. Professor Weitzman stated to the author of this letter that he would be willing to discuss with the NRC the applicability of the declining discount rate to the investment rate. He can be reached at the Harvard University Department of Economics, whose main phone number is 617-495-2144.

We concede, based on Professor Weitzman's 2003 article, that the financial assurance in the first 25 years will likely be invested at a rate that exceeds a 1% real rate. In fact, Professor Weitzman's article states that a 3%-4% return should be assumed in the first 25 years. Weitzman, 91 The Am. Econ. Rev. at 270. However, the enclosed articles also state that this higher rate of return slides downward below a 1% real rate in the far-distant future. Weitzman, 91 The Am. Econ. Rev. at 270; 36 J. of Envtl. Econs. & Mgmt. at 203-207; Neil, Perspectives on Radioactive Waste Disposal at 6. Therefore, if the NRC returns the excess funds to the trust grantor after the first 25 years based on the higher rate of return, as the proposed rule allows, 73 Fed. Reg. at 3824, the trust will run out of money even faster because the NRC is not

taking into consideration the uncertainty and wide fluctuations in the interest rate that pushes the real interest rate below a 1% real rate as time goes on.

The difference between a constant 1% rate and the sliding rate proposed by Professor Weitzman is quite significant for time-frames extending beyond 300 years. Professor Weitzman concludes that the following discount rates should be used:

Time period	Name	(Percent)
Within years 1 to 5 hence	Immediate Future	4
Within years 6 to 25 hence	Near Future	3
Within years 26 to 75 hence	Medium Future	2
Within years 76 to 300 hence	Distant Future	1
Within years more than 300 hence	Far Distant Future	0

When the amount of $5,000,000 is discounted for 900 years using Professor Weitzman's sliding scale rate, this amount becomes $90,103.39. In contrast, when $5,000,000 is discounted for 900 years using a 1% constant rate, the amount becomes $645.26. Thus, the difference between a 1% constant investment rate and the sliding scale investment rate makes a tremendous difference as to how much financial assurance will remain in the far-distant future.

In conclusion, because the consensus among economists is that a sliding discount rate should be used in long-term cost benefit analyses, the NRC should assume the sliding investment rate

set forth above when financial assurance is necessary to maintain and control a decommissioned site containing long-lived nuclides. The sliding scale investment rate is essential to ensuring that there is sufficient financial assurance for a site containing long-lived nuclides, especially when the NRC is relying on a LTC license for institutional controls in lieu of government ownership of the site.

                    Sincerely yours,

                    ANNE MILGRAM
                    ATTORNEY GENERAL OF NEW JERSEY

            By: _Andrew Reese_____
                    Andrew D. Reese
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Enclosures:

M. L. Weitzman, "Gamma Discounting," 91 The Am. Econ. Rev. 260, 261 (March 2003)

M. L. Weitzman, "Why the Far-Distant Future Should Be Discounted at its Lowest Possible Rate," 36 J. of Envtl. Econs. & Mgmt. 201, 203 (1998).

H. Neill and R. Neill, Perspectives on Radioactive Waste Disposal: A Consideration of Economic Efficiency & Intergenerational Equity page 6 (WM'03 Conference, February 23-27, 2003).

Enclosures: 1 and 2

The following enclosures are marked copyrighted and have not been included with the ADAMS copy of this document:

1. M. L. Weitzman, "Gamma Discounting," 91 The Am. Econ. Rev. 260 (March 2003). A full copy is provided at the following web address:

http://www.aeaweb.org/aer/contents/mar2001.html#13

2. M. L. Weitzman, "Why the Far-Distant Future Should be Discounted at its Lowest Possible Rate," 36 J. of Envtl. Econs. & Mgmt. 201 (1998). A copy of this article is provided at the following web address:

http://www.sciencedirect.com/science?_ob=PublicationURL&_cdi=6870&_pubType=J&_acct=C 000066197&_version=1&_urlVersion=0&_userid=5250395&md5=507b17feba508296bee3611f6 6122652&jchunk=36#36

PERSPECTIVES ON RADIOACTIVE WASTE DISPOSAL: A CONSIDERATION OF ECONOMIC EFFICIENCY AND INTERGENERATIONAL EQUITY

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ABSTRACT

There are both internal and external pressures on the U.S. Department of Energy to reduce the estimated costs of isolating radioactive waste, $19 billion for transuranic waste at Waste Isolation Pilot Plant (WIPP) and $57 billion for high level waste at Yucca Mountain. The question arises whether economic analyses would add to the decision-making process to reduce costs yet maintain the same level of radiological protection. This paper examines the advantages and disadvantages of using cost-benefit analysis (CBA), a tool used to measure economic efficiency as an input for these decisions. Using a comparative research approach, we find that CBA analyses appear particularly applicable where the benefits and costs are in the near term. These findings can help policymakers become more informed on funding decisions and to develop public confidence in the merits of the program for waste disposal.

INTRODUCTION

The estimated costs of isolating unwanted long-lived radioactive residues through deep geologic disposal range from $19 billion for transuranic waste at WIPP in New Mexico(i) to an excess of

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$57 billion for high level waste at the Yucca Mountain Project in Nevada. (ii)   There are both internal and external pressures on the U.S. Department of Energy to reduce these high costs (iii, iv) yet maintain public confidence in each project. In high profile environmental projects such as these, policymakers are often conflicted between efforts to promote economic efficiency and efforts to promote public health for both present and future generations.

How useful are cost-benefit analyses for the formation of public policy decisions regarding nuclear waste disposal? Can policymakers assure the same level of radiological protection to both present and future generations utilizing cost-benefit analyses for comparisons? This paper examines the advantages and disadvantages of using cost-benefit analysis (CBA), a tool used to measure economic efficiency as an input in the decision-making process. We consider when CBA is an appropriate input in the decision making process and when other criteria such as intergenerational equity is more appropriate. This paper employs a comparative research approach (v) to examine the efficacy of CBA for public policy decisions on the disposal of nuclear waste.

This paper focuses on dynamic economic efficiency requirements and implications of using a positive discount rate to examine dollar values over short-term versus long-term time horizons. **The remainder of the paper is organized as follows. The next section presents background information** on cost-benefit analysis, nuclear waste disposal, dynamic efficiency requirements, and inter-generational equity issues. **The following section provides an example where a substantive cost-benefit analysis might have helped decision makers. A discussion of these follows. The final section contains concluding remarks.**

BACKGROUND

In evaluating the merits of any proposed endeavor, one generally compares the advantages to the disadvantages to see if it is worth pursuing. Analysts use CBA to quantify the benefits and costs of an endeavor. To do this, both need to be expressed in comparable monetary units and that the comparison be made at the same point in time. When comparing several options, efficiency requires the option where the net benefits are maximized. The implication of using efficiency as an input in regulatory decisions means that resources are being used optimally, a foundation of economic theory.

Critics often cite ethical and moral concerns in using CBA to evaluate regulations with public health and environmental dimensions.(vi) Other critics point to incomplete CBAs as evidence that that the technique is flawed.(vii) Others point to the seemingly impossible task of placing meaningful dollar values on reduced risks to present and future generations. Finally, critics point to the practice of discounting as problematic when comparing present costs and future benefits.

To address these and other criticisms of CBA, a group of economists developed eight principles

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(viii) to guide evaluation of environmental, health and safety regulation. First, compare favorable and unfavorable effects and recognize uncertainties. Second, government agencies should not be precluded from using benefit-cost analysis when developing regulations or setting regulatory priorities. Third, require benefit-cost analysis for major regulatory decisions. Fourth, in regulatory decisions where costs are greater than benefits, recognize that factors other than economic efficiency such as equity within and across generations may be an important factor. Fifth, report best estimates of benefits and costs but care should be taken to assure that quantitative factors do not dominate important qualitative factors in decision-making. Sixth, subject CBA to external reviews. Seventh, create a standard format for presenting results (ix) and finally consider distributional consequences on subgroups of the population. Some principles are clearly administrative (principles 2, 3, 6, and 7) while others are evaluative (principles 1, 4, 5 and 8). The key concepts to gather from this list to be examined further in this paper are time horizon, intergenerational equity, and uncertainty. These principles can be used to examine projects such as the disposal of high level waste (HLW) and transuranic (TRU) waste where many of the benefits will be realized by future generations. The rest of this section is organized as follows: (A) history of CBA, (B) advantages and disadvantages of nuclear waste disposal, (C) use of ionizing radiation to dispose of nuclear waste, (D) dynamic economic efficiency, (E) intergenerational equity, (F) uncertainties, and (G) summary of advantages and disadvantages of CBA.

History of CBA for Environmental Decision Making

Quantifying costs and benefits for radiation protection is not new. The 1977 report by the International Committee on Radiation Protection (x) recommended the use of cost-benefit analyses in determining the acceptability of any operation involving exposure to radiation.

However, there are differences in the legal and administrative bases for economic comparisons using CBA. (xi, xii) When Congress passed various environmental protection laws, specific direction was provided to EPA on the use of CBA. Some Acts such as the Toxic Substances Control Act (TSCA) and the revision of the Safe Drinking Water Act require forms of CBA. Other environmental Acts such as the 1990 amendments to the Clean Air Act, Clean Water Act and Resource Conservation and Recovery Act require EPA to use "maximum achievable control technology." Strong requirements such as these preclude the use of CBA. (xiii) Both Acts dealing with transuranic and high level waste disposal are silent on whether to use CBA.

All Presidents since Carter have issued Executive Orders requiring some form of CBA. (xiv) Both President Reagan and President Clinton issued Executive Orders to federal agencies to do regulatory impact analyses. (xv, xvi)

Background on Nuclear Waste Disposal

Table I summarizes the advantages and disadvantages to present and future generations. The current generation is bearing the costs of the disposal of high level waste (HLW) and transuranic (TRU) waste now since this generation is also the beneficiary of operations that produced the waste; namely electricity from commercial power plants and national security from the deterrent of nuclear weapons. The EPA Standards for TRU waste disposal (xvii) and HLW (xviii) limit radioactive releases for 10,000 years in order to limit adverse health effects of latent cancer fatalities during that period. Local near-term benefits for both TRU and HLW are economic. Costs include small health risks currently and the avoidance of major long-term health risks. We present our results with respect to the relationship between nuclear waste disposal, CBA and intergenerational equity issues below.

Table I: Summary of Major Costs and Benefits of TRU and HLW Disposal

	Costs of Disposal	Benefits of Disposal
Present Generation	To be paid now	Electricity from nuclear power(HLW)
Present Generation	To be paid now	Nuclear weapons deterrence (TRU)
Long-Term Future Generations	Small number of calculated health effects	Prevention of large number of health effects from HLW and TRU

Using ionizing radiation to dispose of nuclear waste

USDOE devotes significant resources to limit the release of long-lived ionizing radiation sources containing mixed fission products and actinides through deep geologic disposal to prevent ionizing radiation exposure to present and future generations.

There are both short term and long term aspects of disposal. Short term considerations include worker and public safety issues. This section considers ionizing radiation sources used in nuclear waste disposal. The extent that ionizing radiation sources are routinely used to aid in the safe disposal of ionizing radioactive waste is generally not recognized. The benefits of these applications used routinely at WIPP are believed to outweigh the risks. We believe the following seven examples of the beneficial use of ionizing radiation should be quantified for both TRU and HLW and the results published to show the merits of these applications. Note that these applications generally entail only 1×10^{11} Becquerel (Bq) (a few curies) in contrast to the 3×10^{17} Bq (7.5 million Curie) WIPP operational inventory or the 5×10^{20} Bq, (10 billion Curie) Yucca Mountain Project inventory.

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1. Site characterization

To determine the characteristics of a potential underground site, gamma ray sources are lowered in a borehole and the extent of absorption or Compton scattering provides information on the soil composition. Similarly, neutron sources (produced by Americium-241 alpha particles reacting with Berylium-9) provide information on any hydrogenous material present by the scattering distribution.

2. Quantity of radioactivity in the drums containing waste

The scattering of neutrons passed through the drums of TRU waste determines the identity and measures the quantity of actinides. This non-invasive procedure does not require the vented drums to be opened , thus avoiding unnecessary radiation worker exposure.

3. Presence of prohibited items in drum

Radiography (X-Ray) helps identify RCRA banned items of pressurized containers in the drums of waste and this non-invasive procedure also avoids the need to open the drums for inspection.

4. Shipping container integrity

The TRUPACT pressure vessels undergo radiography to determine the efficacy of the welds. (xix)

5. Radiation detection instrumentation

Survey meters, such as ionization chambers and Geiger Muller counters, use the principle of ionization to measure the presence of radiation. Radioactive alpha, beta, and gamma sources are routinely used in the various WIPP Laboratories such as EEG's to calibrate equipment such as proportional counters. Biological uptake studies use Carbon-14 and Tritium.

6. Tracer Studies

While tracer studies have not been used at WIPP, the observed migration of cesium-137 from underground weapons testing at the Nevada Test Site provides empirical knowledge on the travel behavior of that fission product for breach and leach calculations.

7. Worker health

Diagnostic radiology (X-Ray), such as chest X-rays, mammography, and CT scans, is used to detect tissue abnormalities.

Non-ionizing radiation applications include lasers in the mine to insure proper alignment in drilling tunnels and ultrasound has been investigated to measure thickness of drums. It also illustrates that ionizing radiation from radioactive waste disposal is not unique. Quantifying advantages and disadvantages of each of these applications helps develop public confidence that

our actions are appropriate.

Dynamic Efficiency: Time Horizon and Discount Rate

There are many different relevant time horizons for the disposal of nuclear waste. Some of these time horizons involve current generations while others involve hundreds of future generations.

These alternative time horizons (t) in nuclear waste disposal require use of a discount rate to conduct a CBA. The discount rate (r) enables economists to compare future values (FV) of dollars with present values (PV). Two formulas (a) discrete formula where

$$PV = FV (1 + r)^{-t} \qquad \text{(Eq. 1)}$$

and (b) continuous formula where

$$PV = FV\, e^{-rt}. \qquad \text{(Eq. 2)}$$

As t becomes very large, the results of both equations approach zero. A positive discount rate greater than 0 is based on the following two assumptions of impatience and productivity of capital. Table II summarizes the relationship between alternative discount rates and time horizons using the continuous formula. The shaded area of Table II represents present values of less than 1% (or 1.00 E-02) of the future value.

Table II shows that for a discount rate equal to 5% or more and a time horizon of 100 years or more leads to a present value of 0. Thus any benefit cost analysis comparing present costs with benefits to future generations of more than 100 years will never pass a cost-benefit test. What is the appropriate discount rate to use for WIPP and Yucca Mountain? This is a subject of great debate with respect to the type of project, public versus private and the desire to emphasize risk reduction benefits to future generations.

Intergenerational Equity

In 1999, Resources for the Future (RFF) published papers by 20 eminent economists convened at a forum sponsored by RFF and the Electrical Power Research Institute (EPRI) to address the issue whether cost benefit analyses of long-term projects should be discounted, what the rate should be, or whether it is even appropriate to use CBA at all in decision-making for the disposal of high level wastes.(xx) The overall view, published by RFF concluded that some form of discounting was appropriate, albeit with limitations, and the rate should be positive. Weitzman(xxi) recommended a stepwise sliding scale in which the rate should be 3 to 4% for the first 25 years, 2% for the next 50 years, 1% for the following 225 years and then drop to zero

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Table II: Present Value of $1 in Future Assuming Different Time Horizons (t) and Discount Rates (r)

Time Horizon	Alternative Discount Rates (r)												
Years (t)	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
1	$1	$9.90E-01	$9.80E-01	$9.70E-01	$9.61E-01	$9.51E-01	$9.42E-01	$9.32E-01	$9.23E-01	$9.14E-01	$9.05E-01	$8.96E-01	$8.87E-01
10	1	9.05E-01	8.19E-01	7.41E-01	6.70E-01	6.07E-01	5.49E-01	4.97E-01	4.49E-01	4.07E-01	3.68E-01	3.33E-01	3.01E-01
20	1	8.19E-01	6.70E-01	5.49E-01	4.49E-01	3.68E-01	3.01E-01	2.47E-01	2.02E-01	1.65E-01	1.35E-01	1.11E-01	9.07E-02
30	1	7.41E-01	5.49E-01	4.07E-01	3.01E-01	2.23E-01	1.65E-01	1.22E-01	9.07E-02	6.72E-02	4.98E-02	3.69E-02	2.73E-02
40	1	6.70E-01	4.49E-01	3.01E-01	2.02E-01	1.35E-01	9.07E-02	6.08E-02	4.08E-02	2.73E-02	1.83E-02	1.23E-02	8.23E-03
50	1	6.07E-01	3.68E-01	2.23E-01	1.35E-01	8.21E-02	4.98E-02	3.02E-02	1.83E-02	1.11E-02	6.74E-03	4.09E-03	2.48E-03
60	1	5.49E-01	3.01E-01	1.65E-01	9.07E-02	4.98E-02	2.73E-02	1.50E-02	8.23E-03	4.52E-03	2.48E-03	1.36E-03	7.47E-04
70	1	4.97E-01	2.47E-01	1.22E-01	6.08E-02	3.02E-02	1.50E-02	7.45E-03	3.70E-03	1.84E-03	9.12E-04	4.51E-04	2.25E-04
80	1	4.49E-01	2.02E-01	9.07E-02	4.08E-02	1.83E-02	8.23E-03	3.70E-03	1.66E-03	7.47E-04	3.35E-04	1.51E-04	6.77E-05
90	1	4.07E-01	1.65E-01	6.72E-02	2.73E-02	1.11E-02	4.52E-03	1.84E-03	7.47E-04	3.04E-04	1.23E-04	5.04E-05	2.04E-05
100	1	3.68E-01	1.35E-01	4.98E-02	1.83E-02	6.74E-03	2.48E-03	9.12E-04	3.35E-04	1.23E-04	4.54E-05	1.67E-05	6.14E-06
200	1	1.35E-01	1.83E-02	2.48E-03	3.35E-04	4.54E-05	6.14E-06	8.32E-07	1.13E-07	1.52E-08	2.06E-09	2.79E-10	3.78E-11
300	1	4.98E-02	2.48E-03	1.20E-04	6.14E-06	3.06E-07	1.52E-08	7.58E-10	3.78E-11	1.68E-12	9.36E-14	4.66E-15	2.32E-16
400	1	1.83E-02	3.35E-04	6.14E-06	1.12E-07	2.06E-09	3.78E-11	6.91E-13	1.27E-14	2.52E-16	4.25E-18	7.76E-20	1.43E-21
500	1	6.74E-03	4.54E-05	3.06E-07	2.06E-09	1.39E-11	9.36E-14	6.31E-16	4.26E-18	2.86E-20	1.93E-22	1.30E-24	8.75E-27
600	1	2.48E-03	6.14E-06	1.52E-08	3.78E-11	9.36E-14	2.32E-16	5.75E-19	1.43E-21	3.68E-24	8.76E-27	2.17E-29	5.08E-32
700	1	9.12E-04	8.32E-07	7.58E-10	6.91E-13	6.31E-16	5.75E-19	5.24E-22	4.78E-25	4.36E-28	3.98E-31	3.63E-34	3.31E-37
800	1	3.35E-04	1.13E-07	3.78E-11	1.27E-14	4.25E-18	1.43E-21	4.78E-25	1.60E-28	5.38E-32	1.80E-35	6.05E-39	2.03E-42
900	1	1.23E-04	1.52E-08	1.86E-12	2.32E-16	2.86E-20	3.63E-24	4.36E-28	5.38E-32	6.64E-36	8.19E-40	1.01E-43	1.25E-47
1000	1	4.54E-05	2.06E-09	9.36E-14	4.25E-18	1.93E-22	8.76E-27	3.98E-31	1.80E-35	8.19E-40	3.72E-44	1.69E-48	7.66E-53
10000	1	3.72E-44	1.68E-87	5.15E-131	1.92E-174	7.12E-218	2.65E-261	9.36E-305	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

after 300 years. Cropper and Laibson (xxii) recommended hyperbolic discounting which leads to a lower annual discount rate in the distant future. Lind (xxiii) notes that the use of discount rates does not provide a complete basis for decision making or for determining what is an optimal policy. The majority of the participants had similar reservations.

Public health officials and environmentalists often disagree with the emphasis economists place on the present as opposed to future values to generations far in the future. So how do we provide assurance that the residual long-term intergenerational risks of health effects are reasonable and equitable? Basically, try to design repositories so as to limit the predicted long-term detriment to future generations to be comparable to allowable radiation doses considered to be acceptable to society today. Hence the issue of selecting an appropriate method to calculate today's value of benefits over a 10,000 year period has, in effect, been sidestepped.

Uncertainties

Developments in science may continue to change the values of benefits in the future. For example, will the allowable annual exposure of 15 millirem (mrem) be an acceptable criterion over the long term future? During atmospheric weapons testing at the Nevada Test Site in 1957, the AEC guide for off-site radiation exposure to any person was 3.9 Roentgen per test series which was essentially the same standard used in previous Nevada test series. (xxiv) The total exposure to any person should not exceed 3.9 Roentgen. This is approximately equal to 3900 mrem. We now consider 15 mrem per year to the reasonably maximally exposed individual to be acceptable for waste disposal in the area adjacent to the Nevada Test Site for the next 10,000 years. (xxv)

Summary of CBA

Table III reports the advantages and disadvantages of CBA. The punchline is that the CBA appears to be useful as an input for short term projects but not long term.

Table III: Advantages and Disadvantages of CBA

Advantages	Disadvantages
Use economic efficiency as an input in decision-making process	Economic efficiency does not include equity (either present and/or future). Difficult to include values for future generations, a significant part of the equity standard.
Monetary values understandable to general public	Seemingly straightforward CBA results on the surface require complex and potentially controversial assumptions based on science, resource requirements of the present generation, and resource requirements of future generations.
Useful as an input in short term analyses	The longer the time horizon, the greater the uncertainties

EXAMPLE

An example where either CBA or cost comparisons might have helped in a decision-making process was the decision to ship TRU waste by truck. DOE announced its decision to transport TRU waste to WIPP initially by truck while reserving the option to use commercial rail transportation in the future. (xxvi) One of the primary factors they based this decision on was dedicated trains are more expensive than trucks. While dedicated rail is significantly more expensive than trucks, shipments could be made by regular rail which is one-third the cost of truck.

While examining the advantages and disadvantages of both truck and rail, Neill and Neill (xxvii) estimate a $600 million savings for using rail at Hanford and INEEL for both CH and RH TRU waste. These findings were examined by the National Academy of Sciences who made a similar recommendation to reevaluate the use of rail for WIPP. (xxviii) Clearly a more rigorous analysis of both the benefits and costs subject to external review before a decision is final might have saved tax payers significant resources.

DISCUSSION

This section discusses the implications of our findings. First, CBA does not appear to be appropriate for all stages of nuclear waste disposal. Given the relative short time horizons where one can make meaningful comparisons between present costs and future benefits, one cannot use CBA when deciding whether or not to build a repository. Given Table II, any time horizon

greater than 50 years will not pass a benefit-cost test. Obviously a time horizon of 50 years is significantly less than the 10,000 year standard for both TRU and HLW.

Second, seemingly straightforward CBA results on the surface require careful examination by external reviewers. Oftentimes the assumptions may not capture important complexities in science, politics and needs of present and future generations.

Finally, the longer the time horizon, the greater the uncertainty. The needs of future generations are not clear. We face tradeoffs between benefits of preventing harm (reducing risks) to future generation and alternative uses of resources today. What will make future generations better off, preventing harm or increasing consumption (nuclear power and nuclear deterrence)? From an economic perspective, current consumption levels build the infrastructure of today and tomorrow (better schools, highways, standard of living etc.). From a public health and intergenerational equity perspective, we owe it to future generations to properly manage our unwanted radioactive residuals.

CONCLUSION

We find that CBA appears particularly applicable where the benefits and costs are in the near term. An inventory of ionizing radiation sources used to help in the disposal of ionizing radiation waste is presented. We find cost benefit analyses applied to long term horizons are problematic and require careful consideration of intergenerational equity issues. These findings can help policymakers become more informed on funding decisions and to develop public confidence in the merits of the program for waste disposal. Along these findings we recommend the following:

1. USDOE should perform CBA analyses on the RCRA requirements for the non-radiological characterization of Mixed TRU waste to determine whether the benefits exceed the costs.

2. USDOE should publish CBA on the various ionizing radiation sources used to insure the safe disposal of ionizing radioactive waste at both WIPP and Yucca Mountain.

The challenges of conducting CBA for intermediate term projects are formidable, but such quantification can contribute substantially to providing a firmer basis for justification to policymakers for funding those projects that are in the national interest and help develop public confidence. While this generation has a moral responsibility to properly manage our unwanted radioactive residuals, it is important to try to calculate the net worth of our actions. These analyses require consideration of not only economic issues, but require consideration of technical, social, logistical, and political issues as well.

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