Risk Analysis, Vol. 20, No. 6, 2000

Intergenerational Risk Decision Making: A Practical Example

Andrew C. Kadak[1]

There is no such thing as intergenerational decision making, at least not yet. In fact, there is no such thing as intragenerational decision making in the context of maximizing overall social good given resource limitations, there are just decisions being made in an ad hoc fashion. Even if one assumes that there is such a thing as intragenerational decision making, no uniform standard or guidance exists to make societal decisions for the common good. Risks to society are judged unevenly within the same agency and across agencies. Decisions are made in isolation and not weighed in the societal context of what is intra or intergenerationally important. The National Academy of Public Administration (NAPA) has set forth a framework for intergenerational decision making that provides a consistent and fair basis for making tough decisions in order to address difficult issues such as the long-term disposal of nuclear wastes. NAPA recognizes that there is an intergenerational obligation that must encompass broader questions than the narrow issue of waste disposal since resources are finite and needs are great. The fundamental principles are based on sustainability with the overarching objective that "no generation should needlessly, now or in the future, deprive its successors of the opportunity to enjoy a quality of life equivalent to its own." Coupled with this objective are four supporting principles of trusteeship, sustainability, chain of obligation, and precaution. The NAPA process also recognizes that no decision can be final and that a "rolling future" view is better than making decisions for "all time." It attempts to balance the needs of the present with those of the future in an open and transparent process that is aimed at producing a decision, not just endless analysis. The U.S. Congress and president should develop a rational standard by which to judge laws that involve intra and intergenerational issues relative to the overall societal good. Present regulations need to be evaluated relative to a uniform level of risk and benefit to assess where the limited money available can do the most good for both the present and future generations in the context of NAPA sustainability principles. It is hoped that decision makers will take a serious look at this process since it can work to resolve stakeholder stalemate.

KEY WORDS: Intergenerational risk; intragenerational risk; decision making; equity; sustainability; resource allocation; Yucca Mountain; high-level waste; Congress; EPA

INTRODUCTION

As part of the letter of invitation to prospective authors for this special collection of *Risk Analysis*, the editors enclosed a brief outline that began as follows:

> It has long been recognized that efficient allocation of societal resources for risk mitigation sometimes involves tradeoffs [*sic*] that weight risks (and benefits) disproportionately between different groups in a society. Such tradeoffs raise dilemmas of equity, justice and

Q1

[1] Kadak Associates, Inc., 253 Rumstick Point Road, Barrington, RI 02806; Kadak@LOA.com.

> fairness that are ethical in nature, and involve some of the most important value issues faced in risk management today. As the effective domain of risk assessment practice is increasingly being extended beyond the present or near-present to more distant risks to health and safety, policy makers are in turn faced with a new set of ethical concerns. These involve, in particular, choices about the need to spend money now but where the harms to be prevented occur primarily on a transgenerational timescale.

The editors cite as an example the issue of the disposal of high-level nuclear waste that is dauntingly challenging in that the wastes need to be isolated from the human environment for 10,000 years. They pose several important questions:

> Stated simply, and in relation to nuclear waste storage, we can ask whether it is fair that a society should spend many billions of dollars now to prevent a given number of statistical fatalities far in the future, when potentially more benefit in terms of lives saved can be obtained from spending only a proportion of the same money to deal with current risks and societal harms (such as poverty)? What issues and conflicts are raised by this very real decision problem? How should we approach the policy making process under such circumstances? And are different societal decision rules and processes needed for different domains of application and scales of time-line?

This article first briefly discusses some aspects of intragenerational equity, effective allocation of societal resources, the differences in regulation of radioactive and nonradioactive wastes, and comments by the U.S. Environmental Protection Agency (EPA) on intergenerational equity. The article then addresses the National Academy of Public Administration (NAPA) panel recommendations with regard to intergenerational and intragenerational risk, and concludes with a set of suggestions for the regulation of geologic disposal of radioactive waste that are consistent with the NAPA panel's recommendations.

INTRAGENERATIONAL EQUITY

The matter of intragenerational inequity with regard to risks is an important one, with relevance to both a national and a global perspective. It is well recognized that there is a wide disparity in income levels in the United States, and that there exists a strong correlation between lower income level and lower life expectancy.[1,2] Such an effect is exhibited very vividly when comparing life expectancies and average income between Third World countries and the United States.

There are also many intragenerational risk inequities present in the United States. The term "environmental injustice" comes up in any discussion in this country of the larger pollution levels to which the groups at the low end of the economic ladder are exposed.[3] Frequently, environmental injustices are imposed upon racial minorities who tend to comprise the poorer classes, often during citing decisions for controversial nuclear (and other) facilities.

Inequities in the availability and quality of health care as a result of low income represent one important example of the influence of economic level upon risk. Of course, this disparity is much larger when comparing Third World countries to the United States.

In the United States, intragenerational decision making attempts to address these inequities but the process does not effectively balance present risks with benefits and costs to allocate resources where they may do the most societal good. There is no standard or guidance that supports such decision making. Risks to society are judged unevenly even within an agency that is charged to protect the public health, safety, and welfare. Decisions are made in isolation and not weighed in the societal context of what is intra or intergenerationally important.

Why is this so? Society's regulatory bodies were created in large part in response to problems that are narrowly focused on specific areas. What is lacking is an integrated risk standard to provide a uniform level of protection or benefit, or a set of policies that allow for nonuniform levels where they are relevant within an appropriately broad perspective. This gap leaves society unevenly protected with a potential for a large misallocation of resources.

Decision Making Today

Regulating risks in the United States today is typically done by legislative mandates that create regulatory agencies to protect the public health, welfare, and the environment. Congress passes legislation to protect the air, water, and land. Each legislative statute is judged to be important in its own right with regulatory guidance aimed at addressing the initiative at hand. The most significant environmental law passed created the EPA and gave it the power to set environmental and regulatory standards without regard to other societal needs. For example, the EPA has the power to set standards for air and water. The laws enabling the EPA to do so, when passed by Congress, were well meaning—to protect the environment. Unfortunately they did not consider other national priorities such as safety, unemployment, welfare, joblessness, or the cure for cancer. Congress gave the EPA all the power it needed to make sure that water and air are protected, to the exclusion of other factors that may in the long run provide more societal benefit. There is a presumption that these other societal needs will be independently addressed. When Congress begins balancing needs against resources, trade-offs need to be made, however, and, depending upon the resources committed to address the existing programs and embedded costs, funds may not be available for those additional programs that may provide more societal benefit.

The Balance Between Risk and Societal Benefit

There are many instances of this lack of balance between risk and benefit, for example, over the years Congress passed several narrow-issue laws relating to radioactive materials. In 1970, Congress passed the Clean Air Act, which gives the EPA the authority to regulate air emissions of radionuclides. In 1974, Congress passed the Safe Drinking Water Act, which gives the EPA the power to regulate (among other things) radionuclides in public water systems. In 1988, the Indoor Radon Abatement Act was passed, giving the EPA the authority to issue voluntary guidelines on indoor radiation exposure.

These laws allowed the EPA to establish regulations and set compliance requirements.[4] The EPA's mandate, as granted by Congress and supported by the courts, was to establish standards on two levels. The first level was to determine what is "safe," which does not mean risk free but an "acceptable" level of risk. If the administrator, however, determines that there is no "acceptable level of risk," he or she can set the standard to zero. The second level is to provide an "ample margin of safety" below the safe level. As a result of court challenges by environmental organizations such as the Environmental Defense Fund, the EPA is not permitted to consider cost and availability of technology in setting emissions standards.

Table I provides a comparison of several 70-year-lifetime radiation risks compared to background radiation, a result of the ways in which different agencies differ in their view of radiation risk, or of different risk levels chosen within the same agency. In 1994 the General Accounting Office issued a report on the lack of a consensus on acceptable radiation risk to the public.[5] A special interagency steering committee was created to resolve these differences without much success.[6]

As can be seen in Table I, the risk levels vary greatly, indicating a nonuniform application of risk to societal decisions considered in the same regulatory area. When costs are considered for the risks avoided, the disparity is even greater, suggesting that resources to avoid risks are misallocated. What is remarkable and is evident in Table I is that the level of protection sought from radiation from man-made sources is two orders of magnitude below that which is already due to natural exposure.

Table I. Comparison of Radiological Risk Standards

Source	70-year-lifetime risk
Natural background (300 mrem/year)	1×10^{-2}
Indoor radon (EPA)	3×10^{-2}
EPA drinking water standard	1.2×10^{-4}
Gaseous effluent from nuclear plants (10 mrem/year maximum allowed)	3×10^{-4}
National Council on Radiological Protection (100 mrem/year from all sources)	3×10^{-3}
Federal guidance (EPA) (500 mrem/year)	1.5×10^{-2}

Note: EPA = U.S. Environmental Protection Agency. All standards assume that the linear nonthreshold theory is valid, which states that any amount of radiation exposure is damaging on a linear basis increasing with exposure, however, this theory has been questioned as to its validity and scientific basis.[32]

EFFICIENT ALLOCATION OF SOCIETAL RESOURCES

In their opening sentence of this issue of *Risk Analysis*, the editors introduce the subject of efficient allocation of societal resources for risk mitigation (p. 759). This is directly related to the issue of intragenerational equity, since the matter of limited resources available for risk mitigation, even in the United States, is evident to any student of the political scene. The large variation in the dollars spent, or that could be spent, to prevent a premature statistical death in the United States is well known, as was recently discussed by Tengs *et al.*[7] Belzer[8] presents strong arguments in Q2 favor of the efficient use of resources available for risk reduction, contrary to several other authors,[9–12] although none of the above addressed intergenerational risks.

Breyer, in his book, *Breaking the Vicious Circle: Toward Effective Risk Regulation*,[13] writes, "Three serious problems currently plague efforts to regulate small, but significant, risks to our health. I call these problems tunnel vision (or "the last 10 percent"), random agenda selection, and inconsistency." Breyer devotes the first part of his book to this topic and presents Q3 a table taken from the 1992 budget that illustrates the very large variation in dollars spent to avert a premature statistical death within and among agencies of the federal government. The variation across agencies is from $0.1 million to $92 billion, and within the EPA alone from $0.2 million to $92 billion. (For the EPA 1990 hazardous waste listing for wood-preserving chemicals, a cost of $5.7 trillion per statistical premature death averted is given.) Breyer identifies the three elements of "the vicious circle" as public perception, congressional reaction, and the uncertainties of the regulatory process.

Cost-Benefit Analysis of Regulations

Protecting the current generation requires establishing standards that are based on a scientific understanding of risks and consequences, and then making a determination as to how much such protection might cost, since resources are not infinite. In most cases, this is not done very well. A review of federal standards as measured by costs expended per life saved shows a huge disparity. Some specific examples of a cost-benefit analysis are as follows: a life of a coal miner is worth $22 million; seat belts are worth $500 per life saved; lifesaving for chemical carcinogens costs $2 million per person; Occupational Safety and Health Administration rules price out at about $2 to $5 million per life saved; and EPA standards can cost $12 million per life saved. A simple, $100 immunization, however, can save a life in Indonesia.[14] These numbers refer to the cost of compliance or achieving the desired result. They are intended to show that there is room for improvement in funds and resource allocation.

A good example of the misuse of resources is that of the Waste Isolation Pilot Plant[15] that recently opened for disposal of transuranic wastes from the Q4 weapons program. This facility cost U.S. taxpayers over $6 billion and took over 20 years to build. It was designed to meet EPA standards that are supposed to protect people 10,000 years in the future.[16] Probabilistic analyses were conducted showing that, over a 10,000-year period—assuming present drilling exploration rates with the spoils of the drilling used by civilizations in the future—the exposed population (whoever they would be) would only receive several millirems per year of radiation. The issue here is not whether to protect people 10,000 years from now. Rather, the issue is the very stringent, EPA standard—some would say unrealistic compared to higher levels of natural background radiation already present—and whether meeting this standard is worth spending that amount of money today.

This question becomes particularly relevant when the National Institutes of Health are struggling to find cures for cancer, which kills over 500,000 people each year. Heart attacks kill close to 1 million Americans each year—one in two Americans. Pneu- Q5 monia claims over 80,000 lives annually while AIDS kills 32,000. Research programs into each of these causes of death are resource limited. The question of how to appropriate finite funds is timely as well since the EPA is proposing a standard for the Yucca Mountain high-level radioactive waste repository that will cost over $24 billion to meet a standard that limits the annual per person dose to 15 millirems per year for 10,000 years into the future.

Cohen presents a different, yet related, argument about future beneficiaries of risk reduction in connection with geologic disposal of high-level radioactive wastes:

> Considering the way people migrate, there is no reason to believe that the human population around the WIPP [Waste Isolation Pilot Plant] site thousands of years from now will be the direct descendants of those living there now. (In fact, those living there now are not even the direct descendants of those who lived there 200 Q6 years ago.) Thus, the people being protected have no closer relationship to us than people now living in underdeveloped nations. There are many ways in which we could spend money very cost effectively to save lives in these nations. According to estimates by the U.S. Agency for International Development and World Health Organization [WHO], about 5 million deaths per year among children could be averted by immunization programs, at costs ranging from $50 per life saved from measles in Gambia and Cameroon to $210 per life saved by a combination of immunizations in Indonesia. In addition, WHO estimates that about 3 million childhood deaths per year could be averted by oral rehydration therapy for diarrhea at costs per life saved ranging from $150 in Honduras to $500 in Egypt. Since we are not spending this money to save present lives, it does not seem reasonable to spend more money to save far future lives. In fact, the amount we spend for the latter should be reduced by a factor representing the probability that a cure for cancer has not been found and that low-level radiation has not been determined to be much less harmful than indicated by current estimates.[17]

DIFFERENCES IN THE REGULATION OF GEOLOGIC DISPOSAL OF RADIOACTIVE AND NONRADIOACTIVE WASTES

What is even more disconcerting is the regulation of chemicals, of which 60,000 are used in general commerce. Chemical carcinogenic effects are largely unknown due mainly to the differences in biological activity and modes of action in the human body. While hundreds of chemicals have been found to be carcinogenic in laboratory animals, evidence of human carcinogenicity exists for fewer than 30 chemicals.[4] What this points out is yet another discrepancy in regulating hazardous substances. Although much is known about the effects of radiation at high doses in Japan, relatively speaking very little is known about the effects of chemicals on public health. Where and how should resources be applied?

Okrent has examined the differences in how the EPA approaches intergenerational equity in regulating the cleanup and geologic disposal of long-lived, nonradioactive hazardous wastes and the geologic disposal of high-level radioactive wastes.[18,19] A major difference between the two is the time line for regulation of risk. In the standard applicable to the WIPP facility for transuranic wastes in New Mexico,[15] the EPA requires that the risk to farmers—who might unknowingly live above or near the facility, drink the water, or use it for agriculture be very small for the next 10,000 years.[16] It is assumed, however, that active institutional controls will not be in place or operation for more than 100 years.

For RCRA (Resource Conservation and Recovery Act) sites that dispose of hazardous wastes such as arsenic and nickel, which never decay, a typical permit may be for 30 years and the total time horizon for which the operator bears responsibility appears to be less than a century.[20] There are no requirements, however, for a risk assessment to determine risks for a century, let alone 10,000 years. The liner systems at such hazardous waste sites are notoriously unreliable and generally last far less than 100 years. There are no institutional controls or other provisions to prevent farmers from settling above the site some hundreds of years later.

The time line also appears to be about 100 years for the cleanup of Superfund sites.[18] In this regard, a paper by Okrent and Xing[21] is of interest. Postulating a RCRA site that has disposed of the carcinogenic metals arsenic, chromium, nickel, cadmium, and beryllium—and a loss of societal memory—a farming community is assumed to settle above the site 1,000 years in the future. Allowing only for the ingestion pathway via fruit and vegetable intake, soil ingestion, and dermal contact, a lifetime cancer risk of the order of 0.3 is calculated. More recently, Shu and Okrent analyzed a Superfund site that the EPA determined would be best closed by capping. The risk to farmers settling above the site hundreds or thousands of years in the future of contracting cancer was calculated to be unity using EPA methodology and parameters.[22]

It is not clear why the EPA appears to have a different set of regulations with regard to intergenerational risk hundreds or thousands of years in the future for long-lived radioactive wastes and long-lived, nonradioactive carcinogens. If future generations were to contract cancer from the disposal of chemical wastes rather than radioactive wastes, does it make sense to plan for risk avoidance of the latter rather than the former?

THE EPA'S VIEWS ON INTERGENERATIONAL EQUITY

The EPA treats the matter of intergenerational equity rather briefly in the discussion of its reasons for adopting the original final standard, 40 CFR Part Q7
191, and in its discussion of later draft standards following remand of the 1985 standard (19). It does not Q8
examine or discuss intragenerational equity.

That radioactive waste disposal standards were being established in isolation from the manner in which the EPA was regulating and planned to regulate disposal of other hazardous wastes is discussed by Egan, who wrote

> However, it must be emphasized that we [at the EPA] do not intend that our decisions about the appropriate level of protection for high-level waste disposal should set precedents for decisions about other types of waste disposal or for decisions about other environmental protection activities. (For example, we do not intend that "no increased risk to future generations" should become a basic principle of standard setting—the technological, economic, and societal aspects surrounding each particular issue should be overriding.)[23]

In his 1991 paper, Foutes, also from the EPA, discussed economic and other aspects of the regulation of geologic disposal of high-level radioactive waste. Among other things, he reviewed the EPA's position on future states of society:

> The ability to predict what advances in science and technology there will be or when they will occur is not yet with us; nor what cultural and societal changes will take place over what intervals. This is true even in the short term. As one begins to contemplate time periods of thousands of years or 10,000 years, recognition is given to the limits of the imagination. Given this, it is understandable and perhaps prudent when attempting to predict future health effects from disposal to make assumptions of stasis: no change from the present in the future ability to avoid or inhibit nuclide releases or to pre-

> vent health effects from such releases. Indeed, in some ways it is assumed that future civilizations will be less advanced than ours. This is implied with the doses to large populations who have no way to detect nuclide contaminants or, if so, no way to prevent their release and con-
> Q9 sumption. The same can be said for the individual.
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> Still, to the science of economics, somewhat predicated on the ability of incentives to invoke solutions, either societal or technical, and of growth and development as the norm, it is a difficult assumption to have to make—that there will be no advances in the sciences and the medical arts in the 10,000 year period of performance for disposal or, that for some reason, they will not have an impact. To some observers of advances in recent years it would seem a good possibility that a treatment for malignant neoplastic cellular processes (cancer) would occur within the next several decades, certainly within the next hundred years. This counter assumption would call the benefits of restrictive disposal over thousands of years into question—but does not and cannot change the way we perform our analysis. And certainly we will win no friends within the environmental community to assume away our radioactive waste disposal problems in the belief that future societies will be able to take care of them. We are today spending billions of dollars to deal with contamination from only a the few decades in the past.
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> Q9 What conclusions can be drawn from the discussion of intractable economic issues? Only that the inability to resolve these issues in a definitive way will continue to create differences among analysts as to the geologic disposal for high-level waste and the value of nuclear power that produces (at least some of) the radioactive waste as a byproduct. At some point a mandate should be sought on how, in a societal fashion, these questions should be answered and remove them as a policy issue. This might remove some conservatism in current assumptions.[24]

Thus Foutes acknowledges the absence of a general EPA policy or even a national policy on how to deal with intergenerational equity, as well as the EPA's very conservative approach. He also does not mention issues of intragenerational equity.

Is there a policy in the United States that can be defined with regard to inequity in intragenerational risk? If not, should this not become a priority item in any consideration of the broader subject of intergenerational versus intragenerational equity? This article does not attempt to offer solutions to the matter, only to highlight its existence. It is believed that the efficient allocation of available resources is one issue at the heart of any discussion of intergenerational versus intragenerational equity.

INTRA- AND INTERGENERATIONAL DECISION-MAKING STANDARDS

The group in charge of intragenerational and intergenerational decision making is the Congress of the United States. At present they have no identifiable standard by which to judge how to allocate resources to do the most good. Should it be left to the court system to be the final arbiter of acceptability using principles of environmental racism, intragenerational and intergenerational inequalities, and harmonization of risks to levels acceptable to society for activities of that society? Is there a better way since neither Congress nor the courts have a standard by which to judge these very complicated matters? There is no guidance for either inter- or intragenerational decision making. How then should decisions be made? Can the system be changed to make it more rational and fair to maximize the benefits to humanity for the finite resources that are available? The author believes the answer to that question is yes but that it will take a congressional action to adopt an inter- and intragenerational set of principles upon which to judge these issues and to monitor the regulatory and agency compliance to these standards. Congress could set a code of intra- and intergenerational ethics that all laws and policies need to meet to assure that societal good is served.

There are many questions that need to be answered in using a rational allocation of resources and benefits process. What is the balance between intra and intergenerational equity? What precisely *is* intergenerational equity? Is it fair? Is money being spent on the wrong things? One of the key elements in a sustainable future is an educated society that is capable of finding solutions to future problems. How is society doing in this category when it comes to investing for the future?

OBLIGATION TO FUTURE GENERATIONS

What is this generation's obligation to future generations? This question was asked of NAPA, a nonprofit, nonpartisan organization chartered by the U. S. Congress to improve the effectiveness and performance of government at all levels. Although nontechnical, its function and organizational framework is similar to the National Academy of Sciences. Membership in NAPA consists of fellows Q10
from the profession of public service and public administration.

In 1994, the Department of Energy (DOE), to its credit, sought NAPA's advice on how to balance risks, benefits, and costs in its decision-making process for the allocation of federal resources to projects that affect current and future generations, including the clean-up of hazardous waste sites and nuclear wastes. Since the money available is not infinite, decisions have to be made on what to do and how to do it.

Because of the DOE's request, NAPA convened a diverse panel to look at intergenerational issues in light of the many long-term stewardship and disposal concerns revolving around the nuclear weapons complex and the disposal of nuclear wastes from the commercial sectors. The time frame is on the order of tens of thousands of years, well beyond society's ability to comprehend and predict with any measurable certainty. The unfortunate truth is that, despite this, decisions have to be made on how and where to dispose of this material. There is much that science can predict and that technology can assure, but the long time horizon stretches the limits of both. Societal decisions still have to be made, however.

The DOE was interested in having input on several specific questions that the panel addressed:

1. How can society deal with the uncertainty of the future in ways that permit current decision making?
2. How can present-day decision makers establish the balance between present and future generational needs?
3. Q11 How can limited societal resources be allocated so that the most serious issues are addressed, and realistic progress can be made?
4. How can decision makers bring the issue of intergenerational equity to the public at large? Why is this important and necessary?
5. How can an intergenerational decision process, and the decisions it makes, be made stable and enduring into the future?

In order to bring more diverse views and value systems to the table and to answer these questions, NAPA held an intensive three-day, managed retreat to focus on the fundamental issues to see if some consensus could be achieved. Participants in the retreat included environmental activists, representatives from Native American tribes, industry and regulatory bodies, artists, university professors, students, young people, engineers, and other scientists. Even though this group came from divergent backgrounds and (most important) value systems, the group was able to achieve consensus on certain principles.

The final report was issued in April 1997.[25] Sadly, it is not being used by DOE management as they struggle with stakeholders in their decision-making process.

INTERGENERATIONAL OBLIGATION DEFINED

The NAPA panel produced what might be described as a seminal report on intergenerational equity that could also be applied to intragenerational matters and the bridge between the two. Their work is not philosophical but practical. The principle of fundamental consensus was built on the foundation of sustainability. The NAPA panel's intergenerational obligation requires that "*No generation should (needlessly), now or in the future, deprive its successors of the opportunity to enjoy a quality of life equivalent to its own.*"

The objective is supported by four fundamental principles that must be taken together to address decisions for multiple generations:

1. *Trusteeship*—Every generation has obligations as a trustee to protect the interests of future generations.
2. *Sustainability*—No generation should deprive future generations of the opportunity for a quality of life comparable to its own. The reduction of resource stocks entails a duty to develop substitutes.
3. *Chain of Obligation*—The primary obligation is to provide for the needs of the living and succeeding generations. Near-term concrete hazards have priority over long-term hypothetical hazards. Putting it another way, there is an obligation to protect future generations provided that the interests of the present generation and its immediate offspring are not jeopardized. This principle provides important guidance on the practical reality of how to allocate resources in a world in which the resources, both financial and natural, are finite. The Chain of Obligation Principle is worthy of more investigation as is sought to balance between intragenerational and intergenerational needs and fairness. The panel recognized that the priority was to protect the present generation and its immediate offspring because if they are not protected, there will be no future generations.
4. *Precautionary*—Do not pursue actions that pose a realistic threat of irreversible harm or catastrophic consequences unless there is some compelling or countervailing need to benefit either current or future generations.

EQUITY DECISION-MAKING PROCESS

Using these four lofty principles for guidance the NAPA panel then considered how they should be used in the decision-making process. There was a realization that not all stakeholders held the same values, and that the impacts on some would be greater than on others. There were significant discussions relating to environmental justice and injustice for the overall societal good.

The panel also addressed the process of decision making involving stakeholders that could lead to a fair decision despite different value systems. Guidance for the process calls for analysis of risks, benefits, and consequences; a public discussion of results with those significantly affected; and a continual evaluation of decisions of previous generations for applicability and appropriateness. The panel introduced the concept of a "rolling future" that acknowledges the reality of uncertainty in generational decision making. A rolling future accommodates changes in values, society, and technology that occurs, over generations. A rolling-future approach recognizes that no one decision can be made for all time nor should it be since things change. What this very important concept means is that one should not expect the decision to be final for all generations or that it is intended to solve all presently perceived problems for future generations. The process proposed is aimed at producing fair decisions.

PROCESS GUIDELINES FOR INTERGENERATIONAL DECISION MAKING

Every step in the NAPA panel's study attempted to be more specific, thereby providing the decision maker not only the philosophical basis for intergenerational equity, but also the key elements to achieving it. These guidelines are aimed at bringing stakeholders together to reach a decision that is perceived to be fair despite not being totally satisfactory to any particular stakeholder—especially to those directly and possibly adversely affected by the decision.

In order to avoid stakeholder stalemate or solutions reached out of expediency that simply can not
Q13 be afforded, the process must be inclusive, open, and transparent. It should seek out public input. It must be honest, realistic, credible, flexible, and capable of change in response to new information. The process must acknowledge and directly deal with, instead of avoid, different value systems. In the decision, the values upon which the decision is made must be explicitly stated since, in the future, the values may be different—leading to different actions as part of the rolling-future approach. The decision must be linked to current institutions. It is not acceptable to assume that there will be a better institutional system to solve the problem, nor should it be assumed that current institutions will, by definition, disappear. Clearly, future institutions will be different, but the rolling-future approach compensates for those changes.

The process should consider risks as well as benefits to each generation. It should be able to identify and discriminate between tolerable and intolerable consequences. The process should acknowledge that there are means of prevention and mitigation in the event that the present decision may not be correct for intergenerational time. The role of technological advancement should not be ignored. Nor should society rely on technology to be able to solve all problems. Last, but certainly not least, the decision process should recognize the limitation in funds and resources to tackle these long-term problems. If not, the process will not be honest and will likely result in wasted resources and public distrust.

A PRACTICAL EXAMPLE

Although is it unrealistic and naive to hope for the kind of action advocated, a start has to be made somewhere. It is instructive to use a particularly challenging intergenerational question to test the NAPA principles and process. A timely issue at present is how to make decisions regarding the high-level nuclear waste repository proposed at Yucca Mountain, Nevada. The National Academy of Sciences, at the request of Congress, convened a special panel to explore what type of standard should be appropriate. They provided their recommendations to the EPA in 1995.[26]

High-Level Nuclear Waste Disposal at Yucca Mountain

The National Academy of Sciences panel on Yucca Mountain did a very good job at capturing the technical issues associated with establishing an appropriate standard. For example, they recommended an individual risk approach that factors humans into the process as opposed to simply applying release criteria. They recognized the importance of integrated performance analysis for the repository rather than subsystem performance standards that constrained overall design. They also pointed out that, although the theoretical time of peak risk is on the order of several hundred thousand years in the future, they believed that current analytical techniques were good enough to make such predictions. They did concede, however, that science cannot provide all the answers to resolve an issue.

The guidance provided by the National Academy of Sciences was to be used by the EPA to establish standards for Yucca Mountain that the Nuclear Regulatory Commission (NRC) would implement in the licensing process. These standards were recently released by the EPA.[27] They call for dose limits to an individual in the vicinity of Yucca Mountain to be less than 15 mrem/year, with a separate groundwater standard of 4 mrem/year for 10,000 years in the future. Q14 These standards are to be met to the NRC "reasonable assurance" standard used to license nuclear power plants for their 40-year licensed lifetimes in the standard NRC adjudicatory licensing process. There is a legitimate question as to whether establishing such a standard makes sense and whether such a process, in which billions of dollars will be spent without great satisfaction to any party, is appropriate for such intergenerational decisions.

So what is an alternative approach? Applying the NAPA guidelines to the problem is one. Accept the Trusteeship and Sustainability Principles. Apply the Chain of Obligation Principle to be sure that society takes care of its own and succeeding generations. Near-term concrete hazards should have priority over long-term hypothetical hazards. For Yucca Mountain, the short-term risks and benefits should be properly apportioned over the long term. The proposed standard of protection should adequately meet current and future safety needs of the repository while not inappropriately denying present financial needs to find a cure for cancer, heart disease, and AIDS. The Precautionary Principle advises us not to do anything or create a situation that can cause irreversible harm.

The key admonition that NAPA offers is that there is no such thing as a perfect solution for all time nor does there have to be one to proceed. Practically speaking, 10,000 years is "for all time." NAPA, in its wisdom, recognized the need to consider a rolling future. The reason they were comfortable with the Chain of Obligation Principle, which gives priority to the present and immediately succeeding generations, was their belief that needs, science, technology, and values change over time and that these should be incorporated in the decision-making process.

The criticism of this approach is that it may suggest that society is simply passing its problems over to succeeding generations and not acting responsibly in the process. While this approach does have elements of such, it is nonetheless realistic in that it attempts to recognize that trade-offs have to be made if the current generation is to have an improved quality of life that will be passed on to succeeding generations.

The following sections discuss the implications of applying the NAPA principles and a rolling-future concept to what science can credibly deliver in an adjudicatory process.[28–30]

Objective

The overall goal for the Yucca Mountain repository is "reasonable assurance of sustained, low risk Q15 to present and future populations" (Trusteeship Principle).

A working standard based on the NAPA principles can be formulated. This standard, comprised of two parts, would pertain to two different periods in the lifetime of the repository (Chain of Obligation Principle):

1. Engineered Barrier Period (up to approximately 1,000 years from emplacement)—A strict, quantitative release limit for the first 1,000 years, consistent with the concept of essentially complete containment. This keeps science credible since containment of this type can be demonstrated. This standard would be applied for licensing of the repository.
2. Geologic Period (from about 1,000 years to beyond 10,000 years)—The intent is to use probabilistic assessment methods to perform integrated system performance analysis of the repository and the potential exposure pathways to the local population group. This standard would be used only for design.

Based on current designs and repository information, this standard results in no projected health effects during the first 1,000 years (over ten generations) and allows a reasonable assessment of future repository performance that can be used to determine long-term site suitability of the repository. The long-term performance assessment can assist in the design by identifying important uncertainties for which additional research may be required, and by identifying enhancements in design for long-term performance. It has the added benefit of public credibility since 1,000 years is within the current frame of history, deals with the intergenerational obligations without compromising scientists or science, and can be verified using man-made analogs.

Intrinsic in this process and in consideration of the NAPA principles of flexibility the following prudence and credibility measures should be taken: (1) during loading of the repository, keep the spent fuel retrievable and continue tests and monitoring for integrated performance model validation, (2) make the process open and the facility available for public view during operation, (3) once the facility is full, keep it open and retrievable for another 50 years for continuous monitoring and further confirmation of modeling validity (Precautionary Principle), and (4) once satisfied that the facility is performing as expected, conduct a closure hearing. If unacceptable for long-term disposal, it is at least in a safe place for long-term storage.

If this process were applied to licensing decisions about Yucca Mountain, it would seem that billions of dollars could be saved that theoretically would be better spent on other, more useful, purposes (Sustainability Principle). While it is recognized that not all the “savings” would be immediately assigned to other beneficial societal needs, at least the option of using this money for such purposes is there in the context of integrated decision making. This process acknowledges that not all can be known at the time of the decision, but applies the concept of a rolling future and the Precautionary Principle. It also uses the principles of risk assessment to provide best estimates of the potential risks to present and future generations. The standard of acceptability is that which the EPA establishes. The fundamental question is whether the EPA standard makes sense as applied for such a long period in light of society’s intragenerational and intergenerational needs.

This is but one example of how to apply intergenerational decision making. To address the process of resource allocation in the context of societal good there needs to be a system by which to judge intragenerational and intergenerational issues. This is where Congress must play a role. It appears that the first step should be an effort to set public health standards using the rationality of the NAPA process. Standards for acceptable levels of public risk need to be established among all regulators, harmonized for all types of hazards, with a perspective that allows for practicality.[1] These need to be balanced against other societal projects, such as education, for which taxpayer dollars must be spent. Making trade-offs between educating the current generation against a hypothetical risk to a generation 10,000 years in the future is not that difficult if one applies the NAPA principles to decisions about the Yucca Mountain facility. Applying these principles and using the money saved from not having to meet unrealistic standards for current educational needs is just one example of an appropriate use. It is high time that society reviews Q16 all single-focus regulations and standards using the NAPA principles to make available the money for projects that can provide more societal good for the present and future generations.

The Need for an Intra and Intergenerational Standard

During the deliberations of the NAPA panel at the retreat mentioned earlier, there was considerable discussion about a legislative initiative to create an intergenerational agency that would review decisions of Congress and other regulators for their intergenerational impacts. While there was some support, most panel participants felt that creating another federal agency in charge of regulating issues was not the right answer to the problem. At this point, however—and in the context of a lack of balance in what is now regulated relative to societal priorities on an intragenerational level—there does appear to be a need for Congress to adopt a standard by which to judge the laws they pass. This is an important point since it is Congress’s obligation to seek maximum societal value given all the priorities the nation faces and in recognition of limited financial resources. This highly idealized notion may not have a basis in reality but it is worth pursuing. Since Congress and the president are the ultimate decision makers in the United States, some guidance needs to be provided for both to not only harmonize risks but also address the benefits that government bestows upon its governed.

The NAPA principles provide such overall guidance. The Trusteeship, Sustainability, Chain of Obligation, and Precautionary Principles work as well for near-term decisions as those for the long term. If, for example, the standard and approach as outlined here were applied for Yucca Mountain, the financial savings could be applied for more useful societal purposes. Justification for such a reallocation could come from adopting of the harmonization of risk principles in the context of how much the reduction of risk is worth in terms of the national wealth and where the

[1] The Health and Safety Executive of the United Kingdom has established a policy that employs the phrase “as far as is reasonably practical” in its approach to public health and safety regulations.

dollars can be best spent. Pivotal is the Chain of Obligation Principle to balance intra and intergenerational needs and fairness. The NAPA panel recognized that the priority is to protect the present generation and its immediate offspring because if not protected, there will be no future generations. Additionally, the current generation, on an intragenerational basis, would benefit from having more harmonized rules that would lead to benefits for all.

SUMMARY

The National Academy of Public Administration has set forth a framework for intergenerational decision making that provides a consistent and fair basis for making the tough decisions in addressing the difficult issue of long-term disposal of nuclear wastes. It recognizes that there is an intergenerational obligation that must encompass broader questions than the narrow issue of waste disposal, since resources are finite and needs are great. NAPA also recognizes that no decision can be final and that a rolling-future view is better able to incorporate present and future solutions than presently trying to come up with answers for "all time." The NAPA panel's principles attempt to balance the needs of the present with those of the future, in an open and transparent process aimed at producing decisions, not just endless analysis.

It is also important for Congress and the president to develop a rational standard by which to judge all laws relative to overall societal good. Present regulations need to be assessed against a uniform level of risk and benefit in the context of the NAPA sustainability principles to determine where the limited money available can do the most good both for the present and future generations. It is hoped that decision makers will take a serious look at this process since it can help to resolve stakeholder stalemates.

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Risk Analysis 20(6) #080 Queries

Author: Please print this file, and respond to the following queries. Insert additions/corrections in the exact location on the page where changes need to be made; and return the complete set of proofs to the address given on the cover sheet.

Q1: Please verify that "(and benefits)" in parentheses is part of original quote. If added by current author, "and benefits" should be in brackets.

Q2: Please provide a complete list of author names for the Tengs reference.

Q3: Please clarify: a table taken from which 1992 budget?

Q4: Please clarify: which weapons program?

Q5: Please clarify "1 in 2 Americans." This implies, from the first part of the sentence, that half the American population dies each year from heart attacks.

Q6: Please verify that the sentence "(In fact, those living there now. . .)" is enclosed in parentheses in original quote.

Q7: Please provide the name of the final standard and the year for the text citation "40 CFR Part 191."

Q8: The same information as in query 7 should be provided for "1985 standard (19)."

Q9: Does this paragraph immediately follow the one preceding it in this quote?

Q10: Please clarify what is meant by "fellows."

Q11: Please clarify: "realistic progress" toward what?

Q12: Please verify the title of the NAPA panel's report (there is a discrepancy between the text cite and the reference name given).

Q13: Please clarify what is meant by "simply cannot be afforded." Does this mean financially? or in some other way?

Q14: Meaning of the beginning of the sentence "These standards are to be met to the NRC. . ." is unclear. Please clarify.

Q15: Please provide a source for this quote in the reference list and a specific page no. for the text cite.

Q16: An "appropriate use" for what?

Q17: Please provide inclusive page nos. for this reference.

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