

**Ethical Considerations  
for Developing Repository Warning Messages to the Future – 16152**

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**ABSTRACT**

One topic being addressed internationally through the Organisation for Economic Co-operation and Development Nuclear Energy Agency initiative on the Preservation of Records, Knowledge and Memory is the nature of messages to be sent into the distant future, and the means whereby to send them. The U.S. Department of Energy Carlsbad Field Office is the owner of a mined geologic repository, the Waste Isolation Pilot Plant. By regulation, this office must implement, prior to the repository being closed, “passive institutional controls” that last as long as practicable. In the case of this specific repository, all the waste is government generated (defense programs) hence all funding is public money. As such, the preliminary vision for this message conveyance is a somewhat elaborate system that includes records rooms, monoliths, and inscriptions in seven different languages. As the time for repository closure approaches, this aspect of the repository investment will incur a considerable portion of the closure funds appropriated by the U.S. Congress. An ethical question that arises concerns the effects of the public investment to be made on the generations paying for it, and the risk-avoidance benefit to be expected for the generations going into the far future. This is an especially pressing question where taxpayer (public) money is involved, although it does not make sense to waste money collected from any source. This paper explores the ethical dimensions of creating a substantial and sophisticated system of warnings that communicates into the future and concludes that the repository warning system needs to be practicable from a technical point of view, reasonable from an investment point of view, and ethical from an intergenerational equity point of view.

**INTRODUCTION**

The advice given to the U.S. Department of Energy by a diverse group of experts on marking the Waste Isolation Pilot Plant repository to ward off future inadvertent intruders was published in 1993 [1]. It has been picked over by investigative journalists over the years since its publication. One of those journalistic interpretations reviewed some of the recommendations made and then suggested

that nothing ought to be done to mark the repository site: "Ultimately the option of doing nothing -- of leaving the site devoid of markers -- seems like the most elegant solution of all. It may at first appear callous, lazy, and irresponsible, but at the very least, this relaxed approach is cheaper than erecting spiked granite monuments and building fancy information centers -- not to mention commissioning additional panels to work out all the details" [2].

This appeal to simply not do a marker system given the difficulty, complexity, and likelihood of failure for this expensive undertaking [2] is not tenable, the international community strongly recommends, and U.S. regulators require, that deep geologic repositories be marked with a message to the future to inhibit inadvertent human intrusion. However, spiked granite monuments are not practicable and information centers do not need to be fancy. There is an ethical obligation to set in motion societal land-use controls and to mark the site, but the investment to be made ought to be reasonable when compared to the societal exposure-risk presented by a deep geologic repository -- which is minuscule by design.

Some of the participants in the original study [1] felt strongly that this monument and information center complex ought to send a value-laden and emotion-creating message essentially apologizing to the future for what was buried here (page F-49):

"The message that we believe can be communicated non-linguistically (through the design of the whole site), using physical form as a 'natural language,' encompasses Level I and portions (faces showing horror and sickness) of Level II. Put into words, it would communicate something like the following:

*This place is a message . . . and part of a system of messages . . . pay attention to it!*

*Sending this message was important to us. We considered ourselves to be a powerful culture.*

*This place is not a place of honor... no highly esteemed deed is commemorated here . . . nothing valued is here."*

Some of the reasoning behind this emotional approach is related by one of the team-members who is clearly attempting to send a value-laden message to the future, and who does not believe that the legally defined "defense only" mission for WIPP will hold forever (page F-150):

"Because . . . it is highly likely that WIPP will be used to store civilian, as well as military, wastes, it is appropriate that the memorial at WIPP serve as a

reminder of the tragic cost of nuclear power as used for “peaceful” as well as intentionally destructive purposes.

“Indeed, the very existence of WIPP with its price tag of well over a billion dollars is a monument to the folly of the nuclear enterprise. We owe it to the public to explain in detail the circumstances surrounding the birth and death of this enterprise.

. . . “The primary task of the Marker panel teams is to devise ways to ensure that the WIPP site not be tampered with over the centuries. It seems to me that an ideal way to accomplish this would be to associate with it a memorial with solemn significance such as is described above. Obviously, no building or plot of ground is destruction-proof, but those known to bear religious, memorial, or emotional significance tend to fare better than most.”

Current thought is that projecting emotions into the future is not what a marker program is about. It is about providing the future with factual information concerning what lies below and what risk it poses if disturbed. Creating emotion in a future society is expensive and may be misleading. This was recognized by members of the panel that registered dissent (page G-84):

“Various members of the Marker Panel have expressed the view that the Marker should be designed so as to achieve maximum aesthetic impact, so as to be seen as a “gift from our century to the future” . . . , involving contemporary artists working on large scale environmental sculpture . . . , or using Jungian archetypal forms to create a mood of dread and danger . . . .

“As a professional artist, I wish to register a dissenting view. I believe that the Marker should be designed purely on functional grounds, and that any attempts to make the Marker some kind of artistic statement are bound to confuse the clarity of the basic message we are trying to convey.”

The 1993 projected costs of the design recommended by the advisory team was acknowledged to be high, but for a reason—the required longevity (page F-91):

“The high cost of the design is not accidental. Any realistic consideration of proposed marker systems will show that a tradeoff exists between longevity and cost. Any above ground marker system secure against the forces of nature is, by necessity, a large system made out of durable materials, as only such a system can afford the loss of material over time without losing its function.”

A dissenting view suggested that risk-avoidance ought to be part of the allowable cost equation (page F-143):

“it seems unlikely that intrusion on such buried waste would lead to large-scale disasters. An analysis of the likely number of death over 10,000 years due to inadvertent intrusion should be conducted. This cost should be weighted against that of the marker system.”

In the safety calculations made for the WIPP repository to show regulatory compliance, there is no estimation of deaths from human intrusions. The US Environmental Protection Agency regulation (40 CFR 191.14(c)) requires that:

“(c) Disposal sites shall be designated by the most permanent markers, records, and other passive institutional controls practicable to indicate the dangers of the wastes and their location.”

Although these markers are to endure as long as is “practicable,” there is no allowance for their effectiveness in the compliance calculations beyond 100 years. Therefore, there are multiple (an average of 8, [3]) intrusions factored into the repository safety calculations for the 10,000-year regulatory compliance cases. In other words the repository meets the EPA performance requirements in spite of repeated intrusions. It would not be expected that intruding into WIPP would result in a consequential exposure to the driller, certainly not a death. Acute exposures are medically treatable, and surface contamination can be cleaned up using current medical and environmental technologies, so the risk to future generations from this repository is low even with multiple intrusions per 10,000 years.

The risk from a well-built and sited repository is neither great nor likely to affect sizable numbers of persons, so what is the proper investment that ought to be made by currently living generations to warn the far future? One opinion cited [2] suggested nothing, which is not tenable. The 1993 advisors [1] suggested an expensive monument project, since it has to physically continue in place for many millennia. But there are other considerations as well, and the ethics of taking sizable fiscal resources from current generations to warn the very distant future of a minor risk to a few, hypothetical, persons, ought to receive serious consideration. The purpose of this paper is to contribute to that consideration.

## **DISCUSSION**

The U.S. Department of Energy’s Carlsbad Field Office, owner of the Waste Isolation Pilot Plant (WIPP), has joined an international discussion of what to do to preserve repository memory into the future. This discussion is organized by the Organisation for Economic Co-operation and Development’s Nuclear Energy Agency (OECD-NEA). The NEA is now in the second phase of an Initiative on the Preservation of Records, Knowledge and Memory (RK&M) concerning deep geological disposal systems. The larger RK&M collation of tasks includes the nature of messages to be sent into the distant future, and the means whereby to send them. The Carlsbad Field Office is

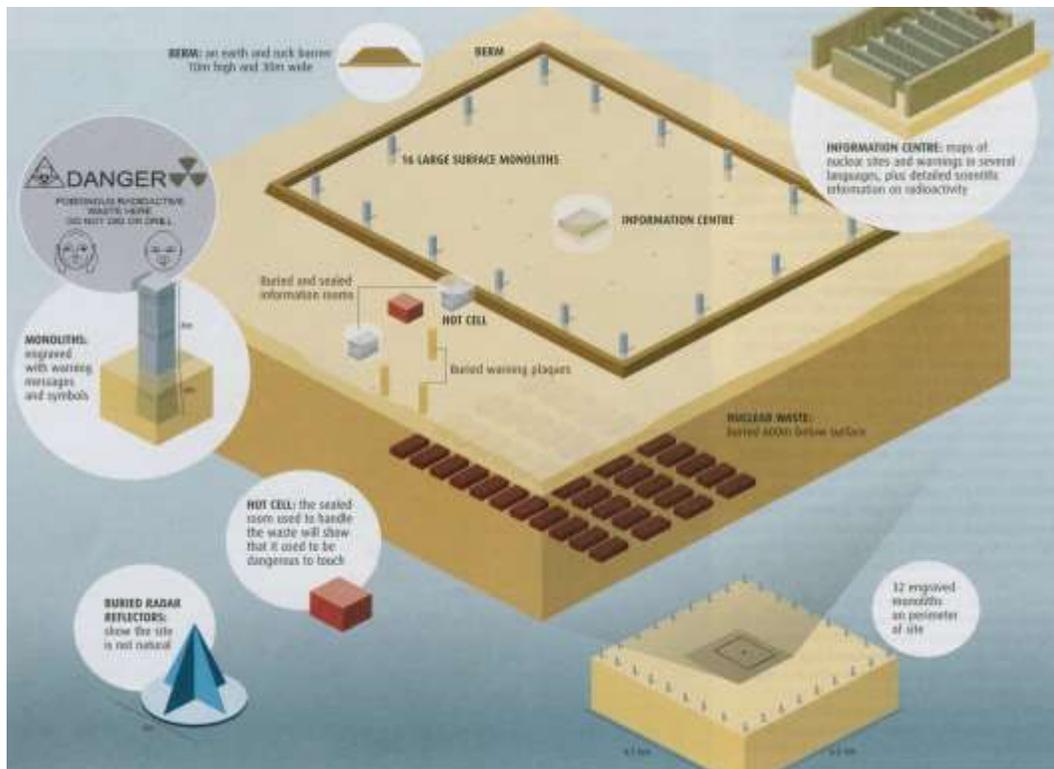
obligated by regulation to create, prior to the repository being permanently sealed and closed, a "passive institutional controls" (PICs) system. Investment in this system should consider not just technical practicality and fiscal reasoning, but also the ethics of intergenerational equity – fairness to both current and future generations.

As indicated in the discussion of the 1993 recommendations [1], the preliminary vision for this PICs message-conveyance system can be somewhat elaborate. Some of the more architecturally and artistically impracticable recommendations were not followed in what has been proposed for WIPP (Figure 1). As the time for repository closure approaches, this aspect of the repository investment will incur a considerable portion of funds appropriated by the U.S. Congress. In the case of this specific repository, all the waste is government generated (defense research and manufacturing programs) hence all funding is public money. An ethical question that arises concerns the burden on the generations paying for this investment now, weighed against the risk-avoidance benefit to generations after permanent repository closure stretching into the distant future, many thousands of years.

This is an especially pressing question where taxpayer (public) money is involved, although it does not make sense to waste money collected from electric rate payers and/or corporate sources either if the message conveyances are ineffective or simply are not mitigating a real threat to future human or environmental wellbeing. This paper explores the ethical dimensions of creating a system of warnings that communicates into the future.

Figure 1 shows an artist's conception of the WIPP marker system, and Figure 2 shows the concept considered for the proposed -- currently cancelled -- Yucca Mountain repository. The concept illustrated in Figure 2 is based on the work done for the WIPP concept but developed it for a mountain ridge setting. Both concepts involved monuments and information vaults above and below the surface.

Both the illustrated concepts involve considerable costs and attempt to achieve the "as long as reasonably achievable" goal for longevity through the selection of materials and the design on durable shapes. Additional record preservation and archiving activities supplement this physical repository marker system. The WIPP version included radar reflectors to mark the site as not natural, and both versions also considered burying smaller warnings on ceramic plaques or fired clay coins or other substances.



**Figure 1. Artist's conceptual drawing of the proposed Waste Isolation Pilot Plant repository markers and information systems**



**Figure 2. Conceptual drawing of proposed (currently cancelled) Yucca Mountain Repository marker and information-monument system**

### **Appropriate Levels of Sacrifice**

On the topic of ethical obligation of current generations to future generations, most references consulted address near-term futures, futures of a few hundred years perhaps. One example is a philosophical article posted online [4] by Payne that observed in part: "Recognizing obligations to the future raises several complex issues. First, there are ethical questions concerning what level of sacrifice our obligations to future generations can demand of us. Presumably we have a clear obligation to adopt practices that would spare future generations likely significant harm if doing so would not significantly undermine our own interests." Payne suggests there may not be much sacrifice involved at all in re-engineering our lives to include more muscle use and not be so energy intensive, a rather near-term suggestion, but the more interesting statement is the one suggesting a balance between potential future harm and current generation interests.

### **Intergenerational and Intragenerational Considerations**

Buchanan [5], coming from a legal perspective, suggested that "a conscious acknowledgement that we are making decisions for people who cannot speak for their own interests creates a moral imperative to give voice to the voiceless." Buchanan then suggests we ought to be more concerned with the current generations who do not share in the wealth that is concentrated into relatively few hands. He observed that "the fundamental problem that we face is not a future with too little prosperity but a future (and a present) in which prosperity is concentrated in far too few hands. This Article thus emphasizes that an obligation to consider future people's needs and desires can fit within well-known conceptions of distributive justice." That remains his theme.

One point that Buchanan makes is that there is no such thing as a generation: "as a literal matter, generations do not exist in any analytically rigorous (that is, nonarbitrary) sense. Even people who were born at exactly the same moment have no reason to believe (even if they are aware of each other and of the coincidence of their moment of birth) that they will die at the same time. The use of the term "generation" thus necessarily implies a clean demarcation that does not exist." He appeals to common sense in suggesting that at any given time there are "four roughly discrete groups of people: today's adults, today's children, people not yet born but who will be born before those living today have died, and those people who will be born after everyone living today has passed on."

Buchanan suggests that "there is a chain of humanity to which we owe an obligation of care. If we believe that all people are deserving of respect and will be born with dignity, then we should respect that dignity by not making decisions that will surely result in their misery. Thus, we can view our obligation not to harm people as an obligation toward *any* person who might come into existence in the

future.” His continuing discussion is philosophical and thought provoking, but at the end he makes a plea to stop worrying so much about the future and look around at the fiscally iniquitous present: “the best approach to analyzing fiscal choices sets aside the whole question of generational membership and simply focuses on distributive issues both within and across generations.”

Buchanan’s conclusion is indeed surprising: “there are, if anything, fairly plausible arguments that we are doing too much for future generations in terms of ensuring long-term economic growth, not too little. Feeling some discomfort with this conclusion, I then discussed how we might actually do better by future generations if we simply focused on present-oriented concerns, specifically: avoiding fiscal crises, maintaining political stability, and weighing policies from a distributive viewpoint.”

Buchanan’s distributive justice point of view is remarkably close to the views on obligations to the future presented to the world by Pope Francis [6]: “Once we start to think about the kind of world we are leaving to future generations, we look at things differently; we realize that the world is a gift which we have freely received and must share with others. Since the world has been given to us, we can no longer view reality in a purely utilitarian way, in which efficiency and productivity are entirely geared to our individual benefit. Intergenerational solidarity is not optional, but rather a basic question of justice, since the world we have received also belongs to those who will follow us.”

Pope Francis, like Buchanan, says we cannot ethically separate today’s marginalized peoples from our concern, our concern ought not be just for the future: “our inability to think seriously about future generations is linked to our inability to broaden the scope of our present interests and to give consideration to those who remain excluded from development. Let us not only keep the poor of the future in mind, but also today’s poor, whose life on this earth is brief and who cannot keep on waiting. Hence, ‘in addition to a fairer sense of intergenerational solidarity there is also an urgent moral need for a renewed sense of intragenerational solidarity’”.

### **Existential Threats**

To introduce another potentially relevant topic, this statement by Pope Francis has been taken out of its intergenerational discussion context: “Doomsday predictions can no longer be met with irony or disdain.” In fact there are several organizations around the world looking seriously at doomsday scenarios of various types. McBain [7] describes this new avenue of research as follows: “While previous doomsayers have relied on religion or superstition, the researchers at the Future of Humanity Institute want to apply scientific rigour to understanding apocalyptic outcomes. How likely are they? Can the risks be mitigated? And how should we weigh up the needs

of future generations against our own?" McBain's article does not answer these questions.

Potential existential threats are brought into this discussion only because the remedies being considered are to be effective over a long period of time -- the human future. This consideration of long timeframes is the only commonality. Well-designed and sealed repositories remove risk from the biosphere. Inherently, they do not present a significant risk to future humanity, but they are often treated as if they do. With respect to existential risks, several experts have warned that these threats to human existence or global well-being are not to be taken lightly.

Sir Martin Rees at Cambridge and Nick Bostrom at Oxford, as well as Tomaso Poggio at the Massachusetts Institute of Technology are recognized authorities on the consideration of existential threats. Rees [8], in an editorial in the journal *Science*, opined that:

Those fortunate enough to live in the developed world fret too much about minor hazards of everyday life: improbable air crashes, possible carcinogens in food, low radiation doses, and so forth. But we should be more concerned about events that have not yet happened but which, if they occurred even once, could cause worldwide devastation.

The main threats to sustained human existence now come from people, not from nature.

But these human-induced threats are different—they are newly emergent, so we have a limited time base for exposure to them and can't be so sanguine that we would survive them for long, or that governments could cope if disaster strikes. That is why a group of natural and social scientists in Cambridge, UK, plans to inaugurate a research program to identify the most genuine of these emergent risks and assess how to enhance resilience against them. True, it is hard to quantify the potential "existential" threats from (for instance) bio- or cybertechnology, from artificial intelligence, or from runaway climatic catastrophes. But we should at least start figuring out what can be left in the sci-fi bin (for now) and what has moved beyond the imaginary.

It seems likely that Rees would not advocate for a huge investment to mitigate a potential low radiation exposure risk to a hypothetical person or group in the future. Society has bigger worries.

Bostrom [9] wrote an extensive article on "human extinction scenarios" and advocated a rather chilling international effort to identify and mitigate existential risks, like Rees. However Bostrom included, as a last resort, the use of effective

force against persons, groups or nations insisting on moving forward with technological developments identified as presenting real existential risks. Preemptive action would be part of the strategy in such a dire case, because there are no second-chances with a true existential risk. Of course the way to prevent this scenario from having to be played out is to carefully manage developments in technology to assure that countermeasures to identified potential existential threats are created at the same time as the technology presenting the potential threat matures.

Bostrom gives a sobering hypothetical example: a dangerous nanoreplicator design that becomes well known as research is published. Nations cooperate on preventing the misuse of this technological advancement. However, in the future, as Bostrom observes:

With this setup, one can confidently predict that the dangerous technology will soon fall into the hands of "rogue nations", hate groups, and perhaps eventually lone psychopaths. Sooner or later somebody would then assemble and release a destructive nanobot and destroy the biosphere. The only option is to take action to prevent the proliferation of the assembler technology until such a time as reliable countermeasures to a nano-attack have been deployed.

Hopefully, most nations would be responsible enough to willingly subscribe to appropriate regulation of the assembler technology. The regulation would not need to be in the form of a ban on assemblers but it would have to limit temporarily but effectively the uses of assemblers, and it would have to be coupled to a thorough monitoring program. Some nations, however, may refuse to sign up. Such nations would first be pressured to join the coalition. If all efforts at persuasion fail, force or the threat of force would have to be used to get them to sign on.

A preemptive strike on a sovereign nation is not a move to be taken lightly, but in the extreme case we have outlined – where a failure to act would with high probability lead to existential catastrophe – it is a responsibility that must not be abrogated.

In all fairness to Bostrom, his preferred option for dealing with existential threats is one of peace and cooperation: "Peace and international cooperation are obviously worthy goals, as is cultivation of traditions that help democracies prosper."

Poggio [10] is apparently not quite as concerned, stating that he is not afraid of intelligent machines in response to the Edge Foundation's Annual Question for 2015, "What do you think about machines that think?"

### **Should we be afraid of machines that think?**

Since intelligence is a whole set of solutions to rather independent problems, there is little reason to fear the sudden appearance of a super-human machine that think[s], though it is always better to err on the side of caution. Of course, each of the many technologies that are emerging and will emerge over time in order to solve the different problems of intelligence, is likely to be powerful in itself and therefore potentially dangerous in its use and misuse, like most technologies are.

Thus, as it is the case in other parts of science, proper safety measures and ethical guidelines should be in place. In addition, there is probably the need for constant monitoring—perhaps by an independent supernational organization—of the supralinear risk created by the combination of continuously emerging technologies of intelligence. All in all, however, not only I am not afraid of machines that think but I find their birth and evolution one of the most exciting, interesting and positive events in the history of human thought.

The long-term safety of humanity from this promising, yet also potentially threatening, advancement in technology is therefore seen as a manageable problem: but managing this problem will require continual monitoring, “perhaps by an independent super-national organization.” Bostrom’s point about needing an enforcement capability to stop dangerous developments is unstated by Poggio.

Where the far future is concerned, the existential-threat abatement community seems to rely on currently non-existing international-scale institutional controls, and is willing to assume that the self-maintenance of these controls continues into the future because of global humanity’s interest in survival as a species. This is a very different approach from what the radioactive waste repository community is doing. However, a radioactive waste repository represents no existential threat at all. Instead, deep geologic disposal facilities present a near-zero risk to nearby populations and present an acute exposure risk to inadvertent intruders, who are hypothetical and uncertain in terms of timing and exposure, and who can be medically treated if exposed. In other words there is no valid comparison between the risk presented by an existential threat and a near-zero risk from a sealed repository.

Moving somewhat away from existential threats, but not completely, is this discussion by Frederickson [11]:

As members of the extended moral community, we have obligations at the least to do no damage to the potential interests of future generations. We can do this better in the near term because our obligations are clearer. We

are, according to Golding<sup>1</sup>, probably too ignorant to plan effectively for remote future generations. Callahan (1981)<sup>2</sup> is more convinced of our obligations. He sets out four principles that catalog our obligations to future generations: (1) We should do nothing to jeopardize their very existence; (2) We should do nothing to jeopardize their fundamental rights to a life of human dignity; (3) We should do this in such a way as to minimize jeopardy to the present generation; and (4) We should use our moral commitment to our own children as the guide for intergenerational fairness.

The fourth point made by Frederickson suggests that his citation from Callahan is not looking at the very distant future, but the first three points are interesting: do not do anything that creates an existential threat, do not do anything that will mess up future lives, but also do not put this generation at risk.

### **A Radioactive Waste Management Context**

Rees [8] mentioned that there are bigger issues for societies to worry about than low radiation doses. In the literature sampled, only one reference directly addresses the obligations of the present to the future in a radioactive waste management context, and does so in a manner not contradictory to the discussion points cited thus far. This is a discussion by Sunstein [12], representing a legal as well as an ethical perspective, and it is cited here at some length to fully allow the argument to be made:

The case of harms to future generations, or people not yet born, is altogether different, and in that case the usual grounds for discounting monetary benefits are quite inapplicable. For this reason some people think that no discounting is appropriate for the nonmonetary benefits of regulation. On this view, a life-year saved is a life-year saved, and it does not matter, for purposes of valuation, when the saving occurs.

But there is a major objection to this way of proceeding: It would appear to require truly extraordinary sacrifices from the present for the sake of the (infinite) future. Perhaps the "failure to discount would leave all generations at a subsistence level of existence, because benefits would be postponed perpetually for the future." On the other hand, it is not clear that the assumption behind this objection is convincing. Technological and other advances made by the current generation benefit future generations as well,

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<sup>1</sup> Golding, Martin P., 1981. "Obligations to Future Generations." In Ernest Partridge, ed., *Responsibility to Future Generations*. Buffalo, NY: Prometheus Books, pp. 61-72.

<sup>2</sup> Callahan, Daniel, 1981. "What Obligations Do We Have to Future Generations." In Ernest Panridge, ed., *Responsibility to Future Generations*. Buffalo, NY: Prometheus Books, pp. 73-88.

and hence impoverishment of the current generation would inevitably harm those who will come later. . . . In any case there is a hard ethical question here – how much the current generation should suffer for the benefit of the future – and a judgment against discounting would not answer that question unless we were sure that as a matter of policy, we should be engaging in maximizing some aggregate welfare function. It is not at all clear that this form of maximization is the appropriate choice to make.

Sunstein speaks of impoverishing the present for the sake of the future, which is perhaps a little more dramatic than warranted for a repository information-preservation problem. But there is a very real ethical question as to what ought to be taken from current and near term generations facing multiple real risks--to protect the far future from a single, uncertain, localized risk. Present generations are facing many risk-laden challenges in real time, and using valuable resources to attempt to warn far-future generations of a potential risk to a hypothetical, unknowing repository intruder is what is at issue.

Sunstein is not the only person to have seen this dilemma of trading the well-being of present generations for the well-being of a small group of hypothetical (and likely medically treatable) exposure-recipients in the far future. The former head of the US Nuclear Waste Technical Review Board, John Garrick [13], observed in the context of the proposed Yucca Mountain repository's million-year safety projections:

. . . radiation dose calculations to date indicate that the margins are substantial between the uncertainties in the calculated dose levels and the levels at which biological damage to humans at the nearest accessible boundary may occur. Even if it turns out that the radiation doses currently predicted at the accessible boundary are wrong by factors of 10 to a 100, the health and safety effects are not calculated to be serious. Furthermore, unlike many threats our society faces, options exist to mitigate any unexpected consequences such as not drinking the water, not consuming the food, and even relocating people, if necessary. Such risk assurances and corrective action options do not exist on many other threats our society faces, at least based on available risk assessments. Examples of such threats are a terrorist attack in major population centers, a major hurricane in New Orleans, an abrupt climate change, an infectious pandemic disease, a large-diameter asteroid impacting the earth, major earthquakes and tsunamis on the West Coast, irreversible pollution of our ecosystem, the increasing obesity of our population, and the use of drugs and alcohol, all of which are a threat to us today, not hundreds of thousands of years in the future where the chance of any biological damage appears to be very small.

In making his statement, Garrick pulls together two elements from our previous discussion: 1) current-generation resources being used to protect the future rather than using them to address real threats in the present, and 2) existential threats to humanity.

These last considerations need to be taken seriously in judging the ethical dimensions of the investment to be made by current society to prevent a potential far-future exposure to a hypothetical intruding individual or a localized group if the intrusion causes enhanced water-borne releases from a repository into a local groundwater source.

## **CONCLUSIONS**

Current generations ought to make a good faith effort to inform, and hence warn, the future of what lies below them in a repository. However, that is not the issue. The issue is how much is being, or will be invested in that warning, how much potential risk is being prevented to whom, and ought not this level of investment be adjusted to balance the mitigation of real risks threatening the well-being of currently living human beings versus future civilizations?

The repository warning system needs to be practicable from a technical point of view, reasonable from an investment point of view, and ethical from an intergenerational equity point of view. As Sunstein [12] rightly said: "Technological and other advances made by the current generation benefit future generations as well, and hence impoverishment of the current generation would inevitably harm those who will come later." Impoverishment of the present is to be avoided for the sake of future well-being.

One final word is appropriate from Sir Martin Rees. It is from his emailed reaction to this paper, which was provided to him for comment: "I am fully in resonance with your view that these 'warnings' are a low priority. The hazard that the repositories present is on a low level compared to many others. Moreover, the world 10000 years from now could be unimaginably different. (Incidentally, it is somewhat incongruous that the specifications for repositories require them to be 'safe' for 10,000 years, whereas in other more important contexts --- securing energy supplies, avoiding drastic climate change, etc. --- it's hard to get policy makers to plan even a few decades ahead.)"

Agreed. Nevertheless it is ethically incumbent on current generations to make a good faith effort to inform the future of risks that have been placed underground.

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