

Risk, Uncertainty, and the Management of Nuclear Waste

October 26th, 2004, 10am –12noon PST

Moderated by Dr. Ann Dale

Participants

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David Shoosmith, Professor, Department of Chemistry, University of Western Ontario, London, Ontario

Dr. Andy Stirling, Senior Lecturer at SPRU (science & technology policy research), University of Sussex

Dialogue

Ann Dale

Thank you, panelists for joining us today in what I hope will be a very interesting conversation. I would like to start by asking everyone to briefly introduce themselves, Bill, do you want to lead the way?

William Leiss

I'm a specialist in risk management and risk communication, interested in the entire suite of health and environmental risks, and I am committed to exploring ways to engage the public in the complexities of risk issues.

Norman Rubin

Norm Rubin here. My little posted bio is a good intro. Every time I look at that (5-yr-old?) photo of me, I think I still look younger than that in the mirror. I've been involved in this field and surrounding fields as a critic for the NGO Energy Probe for a LONG time. . . As luck would have it, Bill and I presented to the "Seaborn" EA Panel on Nuclear Wastes on the same day, back in March of 1996 according to my computer. . .

William Leiss

Fading memory requires me to trust yours, Norm. If you say so, I was there.

Norman Rubin

Bill, the documentation is at:

http://www.ceaa-acee.gc.ca/010/0001/0001/0012/0002/0005/earav_e.htm

Kai Lee

Hi, this is Kai Lee. I am a teacher of environmental studies at Williams College in Massachusetts in the USA. I wrote an issue paper for the Nuclear Waste Management Organization last year on "adaptive" management, a way of trying to learn from experience while undertaking a long-term process like handling used nuclear fuel.

Andrew Stirling

Hi, great to join in this. Andy Stirling here. I'm one of those scientists-turned social scientists, now based at Sussex University in the UK. I'm interested in trying to find practical ways to deal with deep scientific uncertainties. And I work on ways to promote public participation to help take better account of divergent social values and interests in decision making about technology.

Ann Dale

Andrew, I always tease my natural science students by encouraging them to come over to the dark side, the social sciences, where life is more interesting.

David Shoesmith

I also presented to the Seaborn panel but as an AECL proponent of the waste disposal scenario evaluated. I never looked so young in a mirror.

My present position is the NSERC/Ontario Power Generation research chair in fuel disposal chemistry.

Ann Dale

Let us imagine that you are sitting around a kitchen table in Northern Ontario with your grandmother, who does not have a university degree, but who is very wise and has a lot of common sense. She is concerned about the issue of nuclear waste management because of possible sightings of the waste adjacent to her community. She first asks if her understanding of the facts are right--that is, there is currently a total of about 1.2

million used fuel bundles, of which approximately 87% has been produced by Ontario Hydro; 6% by New Brunswick Power and 5% by hydro-Quebec and 2% by AECL.

So, essentially do you guys agree with the figures above and that something more sustainable concerning its disposal has to be done?

David Shoesmith

I have no argument with those numbers and agree that careful disposal is necessary.

William Leiss

SOMETHING has to be done, since the waste is extremely hazardous, in the way of good long-term risk management. Whether the solution is "sustainable" or not is, quite frankly irrelevant. The key criteria are safety, security, affordability, etc.

Norman Rubin

I would have guessed a few more bundles by now, and the use of "Ontario Hydro" rather than "OPG" also makes me suspect the facts are from a couple of years ago, but it's a good enough starting point for me.

At the Seaborn Panel, we were talking about a range between around 3.3 million bundles total (when present reactors shut down) and around 8 million, to fill the "concept" repository, as I recall.

Andrew Stirling

Whoa there! I don't want to get too 'wild and woolly' right from the start. And being a Brit, I'm hardly in a position to second guess the details of the Canadian radioactive waste management scene.

But I'd be careful about kicking off like this with "THE FACTS". A large part of the issue here is that - whilst a load of things are just plain wrong - there are a number of different ways of looking at an issue like this that are equally right. So a single statement of "THE FACTS" can get us into tricky territory quite quickly.

For instance, why stop the account there? There are a bunch of other facts that might already start leading us down different directions.

William Leiss

This part of the matter is not in dispute, Andy; there are about 1.6 million bundles now, going to 3.3 at the end of the useful life of this generation of reactions, for a total of 70,000 tonnes.

Norman Rubin

The last "factual" statement, especially "So, essentially do you guys agree . . . that something more sustainable concerning its disposal has to be done?" may be a tad more arguable than intended. Obviously, we'd all agree that something (including status quo as a default) has to be done, and "done" for a long time, actively or passively. And that we'd like that "something" to be prudent and optimal and legitimate (though we may well disagree about what those terms mean, or how to weigh components thereof).

Kai Lee

One "fact" (the inverted commas acknowledge Andrew's concern) I should add here is that doing nothing also has consequences. These risks seem both small and manageable in a year-to-year sense, but we should not lose sight of the fact that the dangers posed by the radioactive materials will endure for periods much longer than recorded human history.

David Shoemith

It depends what is meant by doing nothing. If a decision to bury them was made today, it would take 25 years to investigate, license and emplace the wastes

William Leiss

Yes, Kai, the default option is to leave it where it is, at the reactor sites; that is, in my opinion, a cop-out and by far the least desirable risk management strategy. And yes, the time frame makes this a most interesting exercise; in the Assessment Team work, we found that a lot of judgments on RM depended upon one's scenario of the likely future of industrial society. (I'm a pessimist on this front.)

Kai Lee

What I mean by "nothing" is an indefinite continuation of the status quo. This is unlikely to be capable of being continued (sustainable) for the duration of the hazards posed.

Norman Rubin

It may also be worth agreeing to the fact that more waste is being added to the total as we "speak", and that AECL and others have plans or dreams to increase the rate at which more waste is being added, with no end or "sunset" in sight. Whether that fact is key or irrelevant is in the eye of the beholder, but it's a fact.

Kai Lee

Norm is right to introduce the dynamism of where we stand. In addition, more used nuclear fuel and other radioactive waste is being generated in the US and other nuclear power producing nations. Some of those materials are both long-lived and highly mobile if released into the environment. This is not just a Canadian problem, although I would suggest we stick to what Canadians should do in this conversation.

William Leiss

Those are not the only plans in the works. A new generation of CANDU reactors using enriched uranium fuel (not before used in Canada) is already in the works.

Norman Rubin

Are you suggesting that using LEU fuel changes the waste equation significantly enough that the basic concerns change fundamentally? I'm just saying that there are still plans or dreams to build more reactors in Canada, so the amount of waste we're talking about disposing is essentially unbounded. Please to solidarity along the lines of "We've already got THE waste, We've got to decide what to do with it regardless" ring hollow (to many people) when most of THE waste We've got to dispose of doesn't exist yet. If the plea for solidarity comes from those who want to increase the rate of waste production, then a greater percentage of the public finds the pleas hollow.

David Shoemith

Bill has a good point. There is an issue of inertia due to the uncertain future of nuclear power generation.

Andrew Stirling

We've pretty quickly got into the territory I had at the back of my mind with the point on 'facts'

How we 'bound' the domain of relevant facts has enormous implications for which way the discussion goes - let alone what we conclude.

The 'fact' that cessation of production is a potentially very concrete management option is often left out of the equation.

Kai Lee

Andrew, you're right that cessation of production is an option — one that is being advanced toward implementation in Sweden, as I recall.

Yet in a world where the Kyoto Protocol is coming into force, and in which demand for petroleum is sending oil prices up sharply, one can think that eliminating existing nuclear power generation won't make sense. And that doesn't even bring in Iran's ambitions.

David Shoemith

Kai, right next door to Sweden the Finns have started the process of licensing a new reactor.

Ann Dale

I think I am beginning to understand a little, is there any consensus among experts about the best way to dispose of this waste, and the risks associated with the options?

William Leiss

Ann, so far as I know - certainly, in North America - our recent exercise was the first time that multiple options (3 in our case) were compared simultaneously and for the same objectives.

David Shoemith

In that very American way, the argument over disposal versus storage is underway in the USA.

Ann Dale

Bill, can you expand on the three options a little? And in your opinion the risks associated with each? And what do others think?

William Leiss

One is deep geological disposal (Canadian Shield), another is centralized storage, either above-ground or shallow underground, the third is continued at-reactor-site storage. There are quite different risk profiles associated with each.

Norman Rubin

To me, one of the key variables in the physical decision (as opposed to the social or democratic decisions) is when -- or even if -- we make the move from managed "storage" to (essentially) passive, unmonitored and irretrievable "disposal". Bill, I don't think the risk profile changes that much (for the first 150 years or so) for natural uranium, SEU (as proposed for Bruce NGS) or LEU. HEU or MOX fuels arguably bring some different concerns, but not these, in my opinion.

William Leiss

No, Norm, the basic case doesn't change with enriched uranium, but the risk management challenges - including terrorism (diversion) risk - certainly do.

Ann Dale

What do you mean about the risks, what are they and is there any way to minimize them?

David Shoemith

I think we should put the amounts of waste being generated into perspective. A fuel pellet the size of the end of your thumb would power your house for a year.

Norman Rubin

David, if these things were dangerous because of their volume -- e.g., they inhabited all the space in a house, forcing the inhabitants out in the cold, so they froze -- your point would be key. In fact, they are primarily dangerous because they are fiendishly toxic, and because they contain the stuff that nuclear weapons are made of. If all the waste

could fit on the head of a pin, with today's total toxicity and weapons-usability I think we'd all agree the situation would be MORE risky, not less. So can we dispense with misleading statements about volumes and hockey rinks, please, at least for today??

David Shoesmith

I am not sure what you mean by discussions about nuclear waste are bounded? There is a furor going on in the USA. There would be here in Canada if we made a decision tomorrow.

David Shoesmith

"Unbounded" suggested infinite volume, Norm!

Norman Rubin

Since those (including many at AECL) who dream of building more nuclear reactors also dream of fissioning most of the U-238 found in natural uranium (2-3 orders of magnitude greater than the U-235 that's now largely fissioned), the total quantity of waste to be produced is infinite to a first approximation, David. A nuclear future need not run out of fuel (or waste-production capacity) for several generations of exponential growth. (The real bounds lie in public acceptability and affordability, IMO.)

Andrew Stirling

With regard to the exchange between Kai and David, I think the real point at issue is not about whether or not we think nuclear power is a pariah or a panacea. It is possible respectably to sustain a variety of arguments in between these extremes.

I think the real point concerns how our visions of the future role for nuclear power intermesh so crucially with the very concrete business of managing radioactive wastes. And yet discussions about radioactive waste management are typically bounded so as to exclude these crucial issues.

William Leiss

On building new nuclear capacity: The RM challenge of finding a decent solution to the existing (and future) waste stockpile, from the existing generation of CANDU reactors in Canada, is bedeviled by the energy policy issues of whether new nuclear capacity is both desirable and publicly acceptable in the future. One can say (as I do) that the two

are not linked, but the suspicion remains; this is a key challenge in the public dialogue on nuclear fuel waste management.

Norman Rubin

I'm puzzled by the "(as I do)" part, Bill. Surely you agree with me that the costs, difficulties, and unacceptability of cleaning up after new reactors should be factored in when deciding whether or not to build new reactors?

William Leiss

Absolutely, for every technology, including nuclear (and mines, and everything else), should incorporate in its cost/rate structures full resources in a sinking fund for complete remediation. NWMO found that the public is scandalized to learn that an adequate long-term solution for nuclear fuel waste wasn't even thought about when the first reactors went into service.

Kai Lee

May I put in a word for our wise grandmother? Bill has brought up 3 scenarios, and Ann has turned our attention to risks.

These are important ideas. They also implicitly accept the usual way we handle technological problems in industrial societies — to think in rational terms about choices and to presume that someone will be around to manage those risks on society's behalf.

Are the grandmothers of Canada all adherents to this belief system?

Ann Dale

Andrew, I think you talked about the results of 63 detailed studies of the overall risks of 8 different electricity options, could you talk about that a little?

Andrew Stirling

Ann asked about a study I mentioned in my discussion paper on precaution for the NWMO.

This was a review of the major international assessments of risks due to different energy technologies. The bottom line is that - whilst individual studies express themselves with great precision - the literature as a whole is in disagreement by many orders of magnitude.

There's a difference of a factor of several thousand between optimistic and pessimistic analyses of the 'risks' or 'environmental costs' of different energy technologies. Using this type of 'science based' risk assessment, it is possible to defend virtually any technology as looking like the 'best' option.

This is an area where the use of these techniques is very sophisticated and mature. So I think there are some pretty tough implications for the use of these kinds of 'science based' techniques as a sufficient basis for decision making on a complex long term issue like radioactive waste management.

Hence I think we need to be careful about being too definite about 'the facts' and be more open to exploring different ways in which they might legitimately be 'framed' and 'interpreted'.

Kai Lee

Hallooo! Grandmother's representative here. (Lucky you: in the US I should be her attorney.)

I'd like to propose that most (not all) citizens would, if they took the time, agree that the technocratic discussion here is a reasonable one. The question of how the technocrats (including expert critics who are not formally within the "establishment") retain the trust of their various constituents is an important one. If you all want to set it aside here, that is fine.

But it is also not clear that citizens' acceptance of the reformulation into technocratic terms means that they will accept what emerges from the debate. I take that to be one of the lessons of Seaborn. So we cannot entirely disengage. Let's put aside till toward the end, Ann, but let's not forget.

William Leiss

I am certainly not a technocrat! The choice of RM options is one that every citizen affected by the decision can and should have important views on. Citizens of Ontario have no choice but to engage in this dialogue - the waste exists, right in their backyards, and the decision options are neither trivial nor inconsequential to them.

Kai Lee

Bill, no offense intended.

I was referring to the terms of the conversation, which are far from Grandmother's everyday experience. I do think most citizens trust people like us to have a reasoned discussion of these matters, even if they do not understand it.

William Leiss

None taken, Kai, I am not thin-skinned in conversational matters.

Ann Dale

You indicated that there are three disposal options, if I am not mistaken, on-site, centralized storage and deep mine. In your opinion, which of these options is less risky and why?

Andrew Stirling

Further to Norman and Bill's exchange I'd add that there seems a further manifest physical linkage between radioactive waste management and the future of nuclear power, in that it is nuclear power that is responsible for the production of the vast majority of such waste arisings.

My point is not that nuclear power should therefore necessarily be phased out simply on these grounds, but that the denial that this is a legitimate part of the discussion risks having the opposite effect to that intended on the political fate of nuclear power.

Ironically, the coupling of discussion of nuclear power and radioactive waste management - far from politicising things - might well have a relaxing effect on certain currently rather intransigent positions.

Norman Rubin

Doesn't that create a strong linkage between the two issues? Just because we can -- by definition -- find a "least bad" solution to the nuclear waste problem, that doesn't/mustn't imply that it's good enough to justify throwing out the first "R" (= Reduce or Reject). And a public that might accept a single waste repository might bristle at the prospect of 100, so the linkage goes both ways.

"How do I get myself out of the corner I painted myself into?" is sometimes a legitimate question, but if it's immediately followed by "And how quickly can I paint myself into another?" then you're dealing with an idiot, no?

William Leiss

There are lots of corners into which we can paint ourselves, Norm, as you well know. No option on energy policy - including radical reductions from current consumption - is without humungous consequences. There is no free lunch!

Norman Rubin

Agreed in full. But some lunches cost more than others, too, and the difference is worth discussing even if "free" is unattainable, right?

William Leiss

Quite so, Norm (we are agreeing too much). It would be ever so nice if we could have a reasoned public debate with all the options on the table (in formal terms, with the risk/cost/benefit scenarios laid out for all to see). Ontario will need such a debate very soon. What is the likelihood that we will get it?

David Shoesmith

Unfortunately, Bill, I see no prospects for a reasoned debate on future energy policy. The energy form adopted will be that which can be implemented most rapidly in order to avoid the approaching crisis.

Kai Lee

Agreeing with Norm that there are lots of corners to paint, and with Bill that we are impelled to spill paint too, might we try to sort out what we could tell Grandmother about the salient concerns regarding the options now under consideration at NWMO?

Norman Rubin

The probability of getting the debate we both dream about is zero to a first approximation. But there will be debate, for sure...

Kai Lee

As I recall, Seaborn agreed to link further production of nuclear waste to the choices concerning the disposition of existing waste. Is that also in NWMO's charter?

William Leiss

No, NWMO is charged under federal law only to recommend a preferred RM option on the existing waste stream to the federal government no later than Nov. 2005.

Andrew Stirling

I wonder whether it might be useful to turn some of our attention away from what are or are not the right 'facts' or boundaries for the discussion and mull over some of the options for different PROCESSES through which these things might be decided ?

Sorry if this is jumping the gun, Ann!

William Leiss

Have you seen NWMO's Assessment Team Report (Sept. 04), Kai? I'm very proud of having been a part of it (Norm is probably less pleased). The basic idea of our comparative assessment was to do it in a way that any interested member of the public could follow - in other words, anyone could, in principle, come to his or her own conclusions by following the steps. It is literally true that, if you follow this method (using small-group consensus), you don't know what the outcome will be until you're finished.

Norman Rubin

I don't think I'm less pleased, Bill -- though I haven't had the time to wrap my head around the report yet. The last NWMO report that I did digest was the result of a large number of cross-Canada focus groups, which reinforced my views (stated earlier) on what Canadians believe, and whom they trust, etc. (I loved it, of course!) In general, I've been quite impressed with the approach that NWMO has taken to their mandate. My left hand is only slightly extended when I say that they are clearly the class of Canada's nuclear industry <g>.

Ann Dale

Okay, I am still no clearer on what my risks are with each of the three options, and I assume each has its costs and benefits? This is a complicated subject and thank you

for your patience with me. But perhaps we need to continue to have these interdisciplinary and multistakeholder dialogues, as Bill has suggested.

Another question for Kai, would we ever trust a council of laypeople to weigh all the costs and benefits and make recommendations, after hearing from the experts?

David Shoesmith

Ann, I am glad you phrased it that way. The technocrats role is not the making of public policy. The public must chose even if imperfectly.

Kai Lee

No one knows, since a permanent disposal option has not been carried out. But in other realms where outright evil has been committed there have been some successes in truth and reconciliation procedures undertaken by people who were trusted to begin with.

I don't think it is so hard for a citizen to believe that a trusted lay person can learn about the technical matters enough to make a reasonable judgment. In that sense, a lay person, suitably engaged and qualified, is more trustworthy than an expert. No, Bill, I didn't know about your new report. It seems to attempt what I'm saying above, and that's the right goal (whatever level of success has been attained so far).

William Leiss

Kai, here's the URL for the report:

<http://www.nwmo.ca/default.aspx?DN=735,20,1,Documents>

Norman Rubin

I'm not sure my favourite option is really among the three, Kai. My background beliefs are:

- The Canadian public hasn't really been adequately involved in setting the QUESTIONS, despite the fact that ~\$1 billion has been spent on answering questions.
- When asked, "normal people" seem to stress their lack of faith in the establishment (nuclear industry and government), and their lack of faith in an unmonitored, irretrievable disposal option.

- By the time ~150-200 years has passed, the fiercely radioactive fractions in CANDU spent fuel will have decayed enough that it will be all too easy for relatively unsophisticated (bad) people (think High School chemistry lab) to extract weapons-usable materials.

Given those beliefs, I'd favour an approach of serious research to improve the ultimate (and in my view) inevitable move from storage to disposal -- though perhaps (and I hope) monitored disposal with some level of retrievability. And that move from storage to disposal should be delayed as long as practicable. At present, I see absolutely no urgency, but if social stability starts going down the tubes, or if a clearly wonderful "disposal" option surfaces, that curve should shift. If the material could be made unusable for nuclear weapons, then basically all urgency to move to "disposal" would vanish, and we'll be optimizing storage for a million years.

What IS urgent is to establish financial and legal mechanisms to ensure that future humans don't have to pay for our wastes, or our mistakes in managing them. That means establishing a much richer fund than now exists (and probably also spending it faster on research than is now being done), and also creating future (innovative) legal-financial guarantees to "make whole" anybody who's harmed in the future. That part IS urgent.

William Leiss

Norm, your reply sounds consistent with favoring deep geological disposal. The site can certainly be left unsealed (making retrievable possible, if difficult) for as long as you want - but, in my own view, you'll never want to reprocess the stuff. But it can also be sealed off and, for all practical purposes, forgotten, if society is no longer robust and there are fears about someone wanting to mine the stuff. By the way, if a bunch of high school kids are capable of rappelling down a thousand metres of shafts, digging through dense clay and breaking into steel and copper containers, more power to them, I suppose.

Kai Lee

Where Norm ends up sounds plausible. Is there a way that such a possibility can be (or is already) being entertained within the NWMO plan?

Andrew Stirling

Ann raises another very important issue.

Is the question whether we 'would' or 'should' trust such a process?

There is sometimes a heavy pressure to 'bolt on' some kind of participatory process at the end (or alongside) the 'main' business of scientific appraisal simply in order to secure greater 'trust'.

If trust is seen in this way as an end in itself, then, such exercises can risk being counterproductive, because the real issue is not whether the public are 'involved' but the specific terms and remits for this.

I think the conditions under which we 'should' trust such a process are probably more important.

Ann Dale

Andrew, such processes must be fundamentally integrated into any decision-making, such as our novel experiment with round tables in the mid-1980s. It is rather like the difference between multi- and inter-disciplinary research? And the building of trust takes time, as we are just beginning to trust one another on-line and we will soon have to end this fascinating discussion. I would like to start introducing questions from the audience shortly, so I don't know if you want to make any further points, before we start them?

David Shoesmith

There has been a major international collaboration on the move towards permanent disposal. One can argue with the value of specific risk assessments but an enormous amount of relevant information is available. One of the problems is encapsulating this information in a publicly digestible form. It would be fair to say not enough effort has gone into this aspect of public presentation.

Norman Rubin

Unfortunately, in the nuclear field, "major international collaboration" usually means that AECL and their 13 international counterparts in the most nuclear jurisdictions on the planet have agreed to something. Often, 6 falsehoods before breakfast, in my view. This is part of how we've spent \$1 billion answering the wrong questions -- like "If you wanted to dispose of this stuff irretrievably, with no monitoring, getting assurances primarily from computer models, how best to do it?"

Andrew Stirling

Speaking as an advocate of public engagement, I do think we need to be cautious about how it is that consensus among a small group of citizens can actually differ from consensus among a group of experts (who are, after all, also citizens).

For what it is worth, my own take is that citizen and stakeholder engagement are at their most valuable where they 'open up' rather than 'close down' the discussion. If they ask new questions, raise new possibilities, bring new questions, inject new values - then they play a key role.

It is in this way that we can look to be more rigorous as a society about exploring the way in which different values interact with the science.

But if these type of 'consensus' procedures are used to 'close down' debate, then they are likely to be as potentially arbitrary, ambiguous or prone to error as I was arguing a while back that the 'science based' processes can be. The trick lies in exactly how we combine the two. The devil is in the detail.

William Leiss

The validity of the cost estimates for the three options is a perfectly legitimate concern. The public needs to pay close attention to this part of the debate. Of course, in Canada the government is the payer of last resort for everything that goes wrong (see the BSE debacle).

Norman Rubin

The prior essential step is to get the laypeople to pose the questions that the experts are to address. Then the experts weigh in, and the laypeople decide what to do based on the best expert input.

I think we have no choice but to trust normal people to perform both functions, because democracy is the best system we've come up with to make important decisions, and this is important.

Andrew Stirling

Norman, I'm with you in the respect for democracy, but there are questions about the extent to which any particular 'participation' exercise is indeed democratic.

For the best of reasons, they are often subject to contingency and deliberate design in much the same way as an analytical process.

In the end, there also has to be a role for wider political discourse and established procedures for accountability in decision-making, as well as for smaller scale exercises in deliberation. The challenge lies in successfully articulating the two.

Norman Rubin

I agree. Unfortunately, realistic "accountability in decision-making" is probably a pipe-dream in the case of disposal of million-year toxic wastes. I've suggested for years (decades?) that if I had one magic-wand wish in this regard, it would be to make the curses of future generations retroactive -- then we'd just have to watch to see who clutches at their throats and drops dead, or descends to Hell in a pillar of flame. (I'm betting on the waste producers and the rapid disposers, but nobody can be certain.) Probably unattainable, though.

Kai Lee

...citizen and stakeholder engagement are at their most valuable where they 'open up' rather than 'close down' the discussion. (Ann wrote)

I see the point, but NWMO's recommendation is a closing down process, is it not?

Andrew Stirling

Actually, I think that was me, Kai. And, yes, as I understand it, you're right.

Norman Rubin

According to a leaked Cabinet Document from a few years back (which I helped leak), the main reason the federal government set up the NWMO rather than a federal agency was to AVOID residual federal financial liability. Sad (disgusting, even!), but true, Bill. I'll send you a copy if you like.

William Leiss

Uncertainty over very long timeframes can only be dealt with by disciplined guesswork. In other words, you have to construct scenarios in your mind about what you think the future will be like (for example, will industrial society persist into the future, or will we

return to hunter-gatherer modes?). Then work backwards to the present, where we have to make a decision.

Ann Dale

I hate to break in, our first question from the audience, "how does one address uncertainty in public values 100, 1000 and ten thousand years into the future?"

Norman Rubin

I think a generally circumspect and humble approach -- e.g., avoiding irreversible steps -- is likely to optimize the choices there. But the future uncertainties are certainly mind-numbingly great, and in both (or even all?) directions. Cancer might be cured forever, internally deposited LLRadiation might be proved to be health-enhancing, all kinds of amazing things could change. That said, extrapolating from past values -- constants, trends, etc., might also make sense.

Kai Lee

To the audience question about public values in the future: I am hard-pressed to know what public values will be in next Tuesday's election in the US. I believe the responsibility of the present generation is to lower the risks handed on to the succeeding generation, while increasing the resources available to them to cope with surprises. This may mean striving for an irreversible solution like geological disposal, but it may also mean centralized monitored retrievable storage. I am most skeptical of at-reactor storage as a way to achieve the objective stated above.

In any event, we cannot control what the succeeding generation does, a truth that grandmother (and every parent) must recognize, whatever risk analysts say!

David Shoemith

The word uncertainty speaks for itself. One tries to construct all feasible scenarios and then to assess their probability. If you are very uncertain, you adopt a drastic solution to cover the possibility you may not be able to comprehend. Those of us who are technocrats then try to specify those uncertainties numerically. Whether non-technocrats accept our analyses is a question of trust and should be based on the right to interrogate us.

In the nuclear waste disposal area we try to cover the uncertainties and the probability we will make some incorrect decisions by having a series of barriers to the release of radioactivity which must not all due to the same mistake. The number of barriers goes up with the uncertainty. So does the cost.

Andrew Stirling

I agree on the key value of humility. The invoking of some simple single notion of the "interests of future generations" can be as problematic as invoking 'objective science' as a way to settle complex current political challenges.

This said, one thing we can be pretty sure of, is that - if there is a society -then social values and interests are likely to be as diverse in ten thousand years as they are now. The problem that people just plain disagree about what's important is inescapable.

Thinking about humility raises real questions as to whether - and under what conditions - we should embark on decisions that have such long term irreversible consequences.

Kai Lee

To Grandmother: this idea still seems like the right approach to _technical_ design, after more than 50 years of studies.

Notice that what we have been discussing during this forum are the more complex issues of trust, procedural design, and social process. On that front, as Andrew points out, we do not have a concept quite as straightforward as multiple barriers. Democratic accountability, as Norm said, is an imperfect objective, important as it is in Canada.

Ann Dale

Another question from our audience, and I apologize in advance for not being able to bring all of them forward, perhaps that will be the topic of another on-line conversation-- "Could the panelists address the risks associated with the three management methods, as it pertains to the Inuit?"

William Leiss

Risk to Inuit: The siting decision will be made later (and of course it will be difficult!). But it is a virtual certainty that, if a single site is the preferred option, it will be somewhere in Ontario, where most of the waste has been generated.

Norman Rubin

There may be fractions of the eventual emissions from a repository (or a failed storage site) that concentrate in high altitudes, as some chemicals now do. I don't think any

serious work has been done on anything in this direction, and it's one of the most egregious omissions from the assessment that AECL did -- virtually ignoring large-scale impacts, which I (and also the Seaborn Panel!) argued had to be assessed and integrated.

Of course, reasonable people can debate the significance of those analyses after they're done, but they should be done.

David Shoemith

All toxic chemicals are toxic forever. Radioactive waste over the million year time frame is no different to other chemicals.

As a radio logic hazard the toxicity of the waste decays to the same level it was when first mined in 300 to a 1000 years. Beyond that there are 2 or 3 radioactive species which would have to be ingested (like other toxic chemicals) to cause a biological hazard.

Andrew Stirling

David, I understand the point you are making. But we should be careful about invoking the authority of science behind a phrase like "no different". There are, of course, many differences.

If science is used to assert this kind of point (and I'm not saying you were doing so, though others have), then it risks discrediting science.

The key issue with regard to irreversibility, is that the production of long lived radiotoxic materials through nuclear power is an avoidable choice. It may be that it is justified. It may be that it is not.

But the use of scientific arguments to circumscribe or discourage discussion of the fact that there does exist such a meaningful choice may not be helpful.

Norman Rubin

I believe all parts of that statement are wrong, David. SOME toxic chemicals are toxic forever, but most are toxic because of their chemical form which changes with time and biology, most often in the "desirable" direction.

Your time-frame for radioactive decay is only true for external, penetrating radiation, which is roughly 0% of the concern with radioactive waste disposal. For toxicity, the time-frame is at least in the OOM of 100,000 years before the material's toxicity drops to the level of the ore -- and it will probably never be as securely stored/sequestered as most of the ore.

David Shoesmith

No, you are wrong, Norm. The question of radiation exposure is the key issue with storage as opposed to disposal. Lead and arsenic are always poisons although we can argue about chemical form. Radioactivity decays with time!

Norman Rubin

1) The "radiation exposure" you're referring to is overwhelmingly (99++++%) by exposure from ingestion, so telling us about a graph of the penetrating radiation that shines off the bundles is totally off base.

2) I said MOST toxic chemicals. . . and the exceptions are toxic ELEMENTS, which you've named two of. Do you stand corrected?

David Shoesmith

As I said we can argue about chemical form, but as long as you acknowledge these are just like most of the other chemicals we don't even try to contain then we have no issue.

Ann Dale

Another question from the audience, "should we be adopting a global rather than just a national strategy?"

Kai Lee

This is perhaps just a unilateral Yank speaking, but I do not think international institutions have a track record, thus far, that justifies a global approach. Moreover, there is much valuable experience being gained from the diversity of national attempts to deal with this problem. As a practical matter, how to respond to the growing use of nuclear energy in developing countries is an international problem that Canada, with its historical role in the international community, may be able to help with. Especially now that the US has squandered the trust gained in the Second World War.

William Leiss

If by a "global strategy" one means a single repository for everybody's waste, then no, it's out of the question, because you'd have to be moving all this very hazardous stuff over long distances, oceans, etc. But if you mean learning as much as possible from others who also have this waste, then, yes, absolutely (and that is being done).

David Shoesmith

In terms of developing solutions we are adopting a global approach. The collaboration between different countries is well established and information is readily shared. I get research money from Sweden, Finland, USA .

A common international disposal site would have huge international opposition and is not feasible politically.

Kai Lee

Another face of the worldwide learning process that is underway is the NWMO itself. If this process succeeds (in some credible sense) in creating a national consensus in Canada about used nuclear fuel, that will be a significant achievement internationally. So the "closing down" aspect of what NWMO does is important far beyond this nation.

Andrew Stirling

With regard to the merit of 'global strategies', I guess there are pros and cons.

On the plus side, if we draw wide enough boundaries of political discussion and policy choice, then it is only in globally-informed energy strategies that we can find a resolution to the many problems of energy use (of which radioactive waste is but one).

On the downside, one of the key issues in this business is the distribution of risks and benefits. A quest for a 'global solution' would have to be very careful to avoid simply reflecting and reinforcing the huge existing worldwide discrepancies of wealth and power.

Norman Rubin

I've been puzzled by the "closing down" suggestion since it was first raised. Sure, NWMO is owned and ultimately controlled by the waste-makers, but they've also done more to involve Canadians in this discussion than anybody in history -- and done it

pretty well, in my negatively biased view! Is the "closing down" a reference to the fact that they're controlled by the nuclear utilities? If not, what?

Frankly, I think there's WAY more hope that NWMO will make smart decisions than that the federal government will, based on structural corruption (the feds essentially own Canada's nuclear industry) and track record (they've never done anything right in this field).

William Leiss

NWMO was "created" under federal legislation and ordered (under law) to bring a preferred solution to the federal government in Nov. 2005. I for one find it amusing that the federal govt. which couldn't find an acceptable solution over a period of 30 years decided to order a non-for-profit entity to do the job in 3.

Kai Lee

I shan't speak for Andrew, who introduced this term, but what I mean is that NWMO has the potential and mandate to restart a national waste management program that went in the ditch with Seaborn. This is an uncommon thing to achieve, and the fact that a leading critic like Norm expresses the confidence he does is also significant.

Andrew Stirling

I think it was me who introduced this notion. I was certainly not referring specifically to the NWMO process - for which I have a great deal of respect. And the point is not that 'closing down' is bad and 'opening up' is good. There is a time and place for both.

The point is that the enormous pressure to justify decisions and foster trust in existing institutions and practices does lead to a certain emphasis of 'closing down' processes over 'opening up'. There is a lot of scope for beefing up our efforts on the latter front and - despite its merits - the NWMO process may not entirely be an exception.

In case anyone is interested, I've attached a recent effort that tries to explore some of the general issues that arise in mulling over this distinction. I'd be interested in others views.

(file attachment: [stirling on opening up and closing down.pdf](#))

Norman Rubin

FWIW, the system's clock is ~2 minutes fast.

www.energyprobe.org has some of the documents I'd cite, and I'll try to make sure the ones I couldn't just find (like our submissions to Seaborn, which are unfortunately still relevant) are restored there.

The issue of acceptable health risk from a repository (which we haven't really broached) gets us into the dichotomy between what's considered an acceptable risk from exposure to radioactive pollution and from non-radioactive pollution, which is both large and important. It's one of the things I think will and must be fixed before we take any irreversible steps.

Kai Lee

I'm a newcomer to the e-dialogue format, so if I may share a comment on our process. This is a slower procedure than an oral panel discussion. That is good and bad. What is bad is that the watchers (including ourselves) can become impatient. What is good is that the writers can be more deliberate, as writing is more deliberate than speaking. I hope the audience will make known its level of satisfaction.

Nuclear waste is a complicated issue, and the more deliberate pace of this discussion seems like a promising development. Notwithstanding the heated debate now in progress on toxicity.

Norman Rubin

Since most of what I've seen from NWMO is tilting away from prompt permanent disposal (based on public input), my confidence in the process is easy.

William Leiss

Norm, by prompt do you mean decades? Nothing will be prompt in this business in the normal meaning of that term. The scenario for DGR envisions beginning emplacement around 2035, if memory serves - and that only if everything goes smoothly between now and then!

Norman Rubin

Yes.

Ann Dale

I have thoroughly enjoyed our kitchen table discussion, but I still need to learn more about this issue, it wasn't quite as simple as just getting the facts right! There are issues of boundaries, framing, trust, decision-making, ethical considerations for future generations, and many more questions from the audience. I would like to invite you all back to my table in December to share your knowledge once again. Thank you for your time, your intellectual sharing and your trust. Are there any last comments before we close, or references you might wish to share?

Kai Lee

Peace to you, Grandmother. This is a conversation that will continue into your children's children's time.

And thank you, Ann.

Andrew Stirling

Thanks to Ann and colleagues and fellow participants for what to this e-discussion novice has been an extremely interesting experience.

Having been so intent on keeping up with the panel discussion, I feel a little disconnected from the wider circle of those involved in this.

I'd be very interested in how the exercise seems from the position of the 'audience'?

Norman Rubin

Andrew, by going out to the e-Dialogues Index, you can peruse the public discussion, I think.

Ann Dale

Andrew, we have a number of interesting questions from the audience that we could not bring forward in the interests of time, and I hope to be able to convince you to participate in a wrap-up e-dialogue where we would bring closure on a number of points raised in this discussion, and the outstanding questions.

Andrew Stirling

Thanks to Norman for pointing out I can check this myself and to Ann for the further invitation.

If I can make a useful contribution some way further down the line, I'd be happy to try.

But many of the unanswered queries that I just took a look at seem quite focused on the scientific specifics.

I'm not sure how content those raising them would be with a response from the likes of me!

With night drawing in over here, I guess I better sign off for now. Thanks again and all the best !

Ann Dale

Thank you again, and to our audience, thank you for tuning in and participating.