To: Impact Assessment Agency of Canada

From: Canadian Coalition for Nuclear Responsibility

Re: Initial Comments from Canadian Coalition for Nuclear Responsibility (CCNR) regarding NWMO's Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project

Date: February 4 2026

CCNR's involvement with used nuclear fuel & NWMO

Dr. Gordon Edwards, CCNR president, has been intimately involved in issues surrounding used nuclear fuel for fifty years. See his House of Commons submissions Nuclear Waste: What Me Worry? (1978) and its sequel Nuclear Waste: What Me Worry Again? (1987).

For a short list of CCNR resources on used nuclear fuel (aka high-level radioactive waste) see www.ccnr.org/hlw_resources_2024.pdf . For a more extensive but still incomplete list of CCNR involvements on this subject over the last five decades, most of them involving Dr. Edwards as principal investigator, see https://ccnr.org/index.html#HLW

On behalf of CCNR, Dr. Edwards provided expert invited testimony on used nuclear fuel to the Royal Commission on Electric Power Planning (1976-77-78), to the Select Committee on Ontario Hydro Affairs (1979-1980), and to the Seaborn Environmental Assessment Panel in the 1980s and 1990s. Two CCNR submissions to House of Commons Committees, authored by Dr. Edwards, are linked above.

Dr. Edwards participated in NWMO's initial public consultations (2002-2005). He and his colleague and fellow Board member Robert Del Tredici were engaged by Inuit Tapiriit Kanatami to make presentations on nuclear fuel waste to four major Inuit communities – at Iqaluit, Inuvik, Kuujjuaq, and Makkovik – along with a senior representative from the NWMO. Dr. Edwards was also engaged by the Assembly of First Nations (AFN) and by CAP (Congress of Aboriginal Peoples) to present on this matter to a number of selected First Nations and off-reserve Métis and Indian communities across Canada.

Later, in the process of site selection, Dr. Edwards was invited by several NWMO Citizens Liaison Committees to provide independent expert information on high-level nuclear waste, in relation to the NWMO DGR proposal, to several candidate communities: English River, Hornepayne, White River, Schreiber, South Bruce, and Manitouwadge.

He was also invited to present independent expert information related to the NWMO project to Wabigoon Lake First Nation, Pic Mobert FN and Pic River (Biigtigong) FN, as well as to the Treaty 3 Grand Council in Kenora, and to the Anishinabek/Iroquois Alliance on Radioactive Waste at the Chiefs of Ontario head office in Toronto.

In 2019 Dr. Edwards was included in an Indigenous delegation (including five Chiefs from the Anishinabek/Iroquois Alliance) to present at the Permanent Forum on Indigenous Issues on the subject of "Radioactive Wastes and First Nations in Canada".

CCNR's Comments on NWMO's project description

(1) Need for an Objective and Impartial Panel Review

The complete isolation of high-level radioactive waste (used nuclear fuel) from the environment of living things, for a period of time that dwarfs the span of human history, is a major unsolved problem of the human race. Among other things, the future of the nuclear industry is contingent on finding a scientifically demonstrable and socially acceptable solution to this problem, as documented below. The stakes are very high.

A thorough and far-reaching impact assessment guided by an independent and impartial review panel is essential to provide a high level of assurance that the industry's chosen site for a Deep Geological Repository for storing and ultimately abandoning some 3.9 million CANDU fuel bundles meets stringent criteria.

In 1976 Sir Brian Flowers, a British nuclear physicist who presided over an inquiry into nuclear energy and the environment conducted under the auspices of the UK Royal Commission on Environmental Pollution, concluded in his final report as follows:

- *There should be no commitment to a large programme of nuclear fission power until it has been demonstrated beyond reasonable doubt that a method exists to ensure the safe containment of long-lived, highly radioactive waste for the indefinite future. (Flowers Report, Summary of Principle Conclusions and Recommendations, para. 533)*

We are confident that an acceptable solution will be found and we attach great importance to the search; for we are agreed that it would be irresponsible and morally wrong to commit future generations to the consequences of fission power on a massive scale unless it has been demonstrated beyond reasonable doubt that at least one method exists for the safe isolation of these wastes for the indefinite future. (Flowers Report, para. 181)

Nuclear Power and the Environment, Sixth Report of the
UK Royal Commission on Environmental Pollution
~ commonly known as the Flowers Report

These conclusions were endorsed in 1978 by the Ontario Royal Commission on Electric Power Planning, presided over by Arthur Porter, who concluded after many months of testimony and cross-examination of nuclear industry spokesmen:

- *An independent review committee should be established to report to the Atomic Energy Control Board (AECB) on progress on waste disposal research and demonstration. If the committee is not satisfied with progress by 1985, a moratorium on additional nuclear power plants would be justified. (Major Findings and Conclusions, p. xiii)*

A Race Against Time, Interim Report on Nuclear Power, Sept. 1978
Ontario Royal Commission on Electric Power Planning
~ commonly known as the Porter Commission Report

These findings from two Royal Commissions of Inquiry reveal a potential conflict of interest – is the goal to preserve the nuclear industry or to protect the health and safety of the environment and future generations? Both are stated goals. These goals are not necessarily opposed, but what happens if they come into conflict due to unexpected circumstances? The nuclear industry cannot be seen to fail in its efforts to permanently and safely store high-level radioactive wastes in perpetuity, for such failure may very well mean the end of the industry. What if it fails and no one learns about it in time?

In Germany, information about the unexpected leakage of radionuclides from a deep underground disposal facility for low and intermediate level waste – the Asse-2 salt mine – was kept from government authorities for years. The scandal would have been – and eventually was – seen as very poor public relations for the nuclear industry. The Asse-2 repository was subsequently declared a failure. The government is spending billions of euros to bring all of the nuclear waste back to the surface again.

The Nuclear Waste Management Organization is a creature of the nuclear industry – that is, of the waste producers. It is particularly important for public confidence that the Agency provide the necessary degree of objectivity and impartiality – and thorough scrutiny – to ensure the assessment process is entirely credible, leaving no stone unturned and no presumption unchallenged.

(2) Need to examine alternatives to the NWMO proposal

The assessment must carefully consider ALTERNATIVES to the proposed transport and burial of high-level radioactive wastes as proposed by NWMO. One such alternative is to continue to safely manage the nuclear fuel wastes at the reactor sites, at least until the production of new nuclear waste at the surface has ceased. See www.ccnr.org/Rolling_Strewardship.pdf .

On-site storage of the waste at reactor sites is one of three methods for used nuclear fuel management that is specified by the Nuclear Fuel Waste Act in article 12(2). According to article 12(1) NWMO is obliged to consider each of these three options "as the sole basis of at least one approach". Accordingly, NWMO in its 2004 Report "Understanding the Choices", wrote:

> At-Reactor Storage
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> Advantages: No transportation of used nuclear fuel would be required as the used fuel would remain next to where it is generated. Each of these sites already houses nuclear installations, so there is nuclear expertise on site and in the existing communities. These communities are familiar with the presence of nuclear facilities, including storage of used nuclear fuel. Further, the ability to monitor the performance and the flexibility to adapt to changing conditions should be facilitated. The science and technology required are well in hand.
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> *NWMO, Understanding the Choices, 2004,*
> *Discussion Paper #2*

Years earlier, the "on-site" storage option was a principal recommendation of the Porter Commission's 1978 Report on Nuclear Power in Ontario, "A Race Against Time":

- The hazards associated with transportation, in particular the possibility of accidents and the threat of hijacking, are real possibilities. Hence, the minimization of handling and transporting spent fuel is a desirable objective. (p. 91)
- We prefer on-site (i.e. generating station site) spent fuel storage to a centralized facility. We believe that a central facility would presuppose the reprocessing of spent fuel; it would also involve more transportation and social and environmental problems. (p. 95)

Ontario Royal Commission on Electric Power Planning
A Race Against Time, pp. 91 & 95

Both bodies made it very clear that avoiding the dangers of transporting used nuclear fuel is a major advantage of on-site storage, which implies that those same dangers are a major disadvantage to NWMO's current proposal before the IAAC and therefore must be assessed.

(3) Is the NWMO project complicating the problem without solving it

The notion that Canada's high-level radioactive waste may be safely stored in deep underground chambers, thereby making the surface of the Earth safer and more secure, having been freed of such hazardous materials, is an appealing fantasy. However it is not a realistic portrayal of the NWMO project.

As long as existing reactors continue to operate and new ones are being built, the production of high-level radioactive waste will continue unabated. Since used nuclear fuel must be stored underwater for several years at the reactor sites, and then moved into dry storage containers on site for at least two or three decades before NWMO will consider moving it to the site of a proposed DGR, the surface will remain congested with a very large inventory of unburied nuclear fuel waste no matter how fast the older waste is being buried.

So, realistically speaking, the goal of making the surface of the Earth safer and more secure from the hazards of nuclear waste cannot be satisfied. Each reactor site will have thirty years worth of used nuclear fuel stored on site, even as the older waste is being buried. Under these circumstances, it is not even conceptually possible to eliminate the hazard of nuclear waste from the surface. In fact, NWMO will have added one more site (the site of the DGR) where large accumulations of nuclear fuel waste will be located, and at the same time will have created a network of routes by which used nuclear fuel will be transported for decades, over hundreds or thousands of kilometres of public roads or rail lines, where new hazards – violent accidents or high jackings or other malicious acts – can more plausibly occur.

Assessing the NWMO project requires answering the questions – What? Why? Where? and When? If the purpose is to make the Earth safer by burying highly dangerous radioactive waste underground, now is not the time to do it. With the proposed building if many new larger and smaller nuclear reactors – at Peace River in Alberta, at Bruce in Ontario, at Wesleyville near Port Hope, at Point Lepreau in New Brunswick, and in several other locations, the idea that only 3.9 million CANDU fuel bundles from existing nuclear reactors will need to be accommodated is clearly unrealistic. Proceeding at this time will complicate the high-level radioactive waste problem without solving it.

NWMO and the nuclear industry generally have always insisted that on-site storage of used nuclear fuel is safe now and can remain safe for at least a century or two, or even much longer with monitored and retrievable storage and repackaging as needed. It is important to realize that these highly toxic waste materials did not even exist 100 years ago, as nuclear fission was not discovered until 1938-1939.

If NWMO argues that it is too dangerous to leave these wastes at the surface for a century or two, then there should definitely not be any new reactors built nor should the old reactors enjoy an extended lifetime, for these facilities will inevitably be surrounded by several decades worth of freshly produced used nuclear fuel – even more radioactive and containing much more volatile species of radioactive gases and vapours than much older used fuel that can be buried underground as NWMO proposes.

(4) Assessment of transportation and fuel handling is essential

As clearly indicated in item (2) above, the hazards of transportation are of paramount importance in assessing the impacts of the NWMO proposal. Foregoing these risks is the most important argument in support of on-site storage, and is identified as such by both NWMO and the Ontario Royal Commission. Transportation of the highly radioactive used fuel bundles also requires handling of the fuel – in some cases moving used fuel from dry storage containers into transport containers, and in all cases moving spent fuel from transport containers into copper-coated steel "burial" containers.

Because of the still formidable external penetrating radiation from the used fuel bundles (gamma and neutron emissions) as well as the ever-present danger of air-borne releases of gases, vapours or aerosols through cracks, pin-holes or other physical defects in 30-year-old fuel bundles, or much larger releases from badly damaged fuel, the risks of handling and transporting 3.9 million fuel bundles is more hazardous than keeping them stored on site.

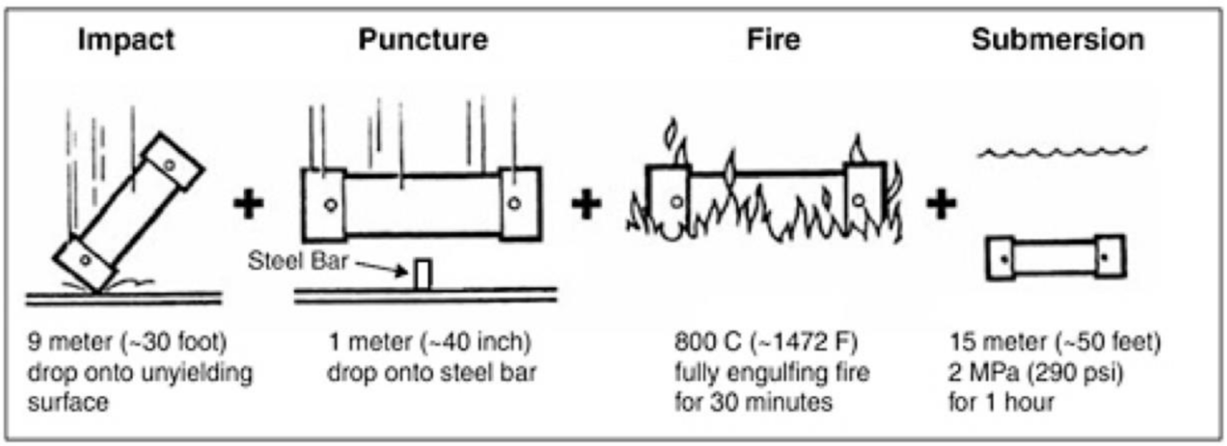
For example, in each used fuel bundle, it is known that approximately 2.2 percent of the total inventory of highly radioactive gamma-emitting cesium-137 is in the "gap" between the ceramic fuel pellets and the outer metallic "sheath" or cladding of the fuel bundle. That means that any mechanical damage penetrating the thin and radiation-embrittled cladding can release that fraction of cesium-137. It is immediately releasable.

Well 2.2 percent of 3.9 million bundles is 86,000 bundles – so the amount of "releasable" cesium-137 from 3.9 bundles is equal to the TOTAL amount of cesium-137 in 85,000 bundles. That's the number of bundles contained in the fully loaded cores of 13 or 14 Darlington-sized CANDU reactors. That is one heck of a lot of cesium-137 that is available to be released simply through mechanical damage to old fuel bundles.
Not to include transportation of used fuel in the assessment of NWMO's project would make a mockery of impact assessment in general, since the solitary reason for transporting the waste is to accord with NWMO's proposal. CCNR insists however that it is not just the transportation of the wastes over public roads or rail lines, but the handling of the wastes at both ends, – departure and arrival – that must be assessed. As we understand it, this would involve the use of robotic manipulators in hot cells upon arrival at the DGR site, and possible a similar use of hot cells prior to departure.

(5) Assessment of transport containers under accident conditions

NWMO maintains that containers designed to carry used nuclear fuel are tested to ensure they can withstand various kinds of accidents without dispersing their contents. CCNR has learned that these tests have, for the most part, been carried out only with scale models (not using the actual containers), and without the presence of a radioactive payload inside the container during the test.

For example, the impact limiters at each end of the transport container would be of little use if the container were to fall off a bridge, making a sidewise impact on an unyielding and uneven surface like a concrete bridge pier or abutment. For example, "the Peace Bridge near Buffalo, New York, in places, is 100 feet high. If the container dropped off the bridge and the cask hit the concrete pier it would be traveling 80 mph on impact; the cask would be so damaged, particularly if it struck the pier sideways, that it would very likely release its contents." (Gordon Edwards and Marvin Resnikoff, 2017, p. 3, www.ccnr.org/GE-MR_2017_rev2.pdf)



Moreover, the "Fire" test involves an 800 degree C fire lasting for 30 minutes. However, most diesel fires occur at a much higher temperature (1000 degrees C or more) and may last for a much longer time. Such temperatures can melt the lead shielding inside the transport container (intended to attenuate the penetrating gamma radiation) and cause more extensive damage. See the Edwards/Resnikoff paper linked above.

NWMO claims about the integrity of transport containers for used nuclear fuel need to be questioned and thoroughly assessed.
In addition, the accumulation of public exposures to gamma rays and neutrons given off constantly during transportation of spent fuel must be assessed in terms of the collective dose to the population of those living along the transportation routes, whether in vehicles or homes or rest stops, over the entire period of anticipated transportation.

(6) Special attention must be devoted to Indigenous knowledge

The Impact Assessment Act requires that special attention be paid to the rights and insights of Indigenous peoples; hence the assessment of the NWMO proposal should include explicit consideration of the Joint Declaration on Radioactive Waste Transport and Management by the Anishinabek/Iroquois Alliance, especially with regard to the Five Principles copied below. See www.ccnr.org/Joint_Declaration_2020.pdf .

> 1. No abandonment
> Radioactive waste materials are damaging to living things. Many of these materials remain dangerous for tens of thousands of years or even longer. They must be kept out of the food we eat, the water we drink, the air we breathe, and the land we live on for many generations to come. The forces of Mother Earth are powerful and unpredictable and no human-made structures can be counted on to resist those forces forever. Such dangerous materials cannot be abandoned and forgotten.
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> 2. Better containment, more packaging
> Cost and profit must never be the basis for long-term radioactive waste management. Paying a higher price for better containment today will help prevent much greater costs in the future when containment fails. Such failure will include irreparable environmental damage and radiation-induced diseases. The right kinds of packaging should be designed to make it easier to monitor, retrieve, and repackage insecure portions of the waste inventory as needed, for centuries to come.
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> 3. Monitored and retrievable storage
> Continuous guardianship of nuclear waste material is needed. This means long-term monitoring and retrievable storage. Information and resources must be passed on from one generation to the next so that our grandchildren's grandchildren will be able to detect any signs of leakage of radioactive waste materials and protect themselves. They need to know how to fix such leaks as soon as they happen.
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> 4. Away from Major Water Bodies
> Rivers and lakes are the blood and the lungs of Mother Earth. When we contaminate our waterways, we are poisoning life itself. That is why radioactive waste must not be stored beside major water bodies for the long-term. Yet this is exactly what is being planned at five or more locations in Canada, including Kincardine on Lake Huron, Port Hope near Lake Ontario, Pinawa beside the Winnipeg River, and Chalk River and Rolphton, both beside the Ottawa River.
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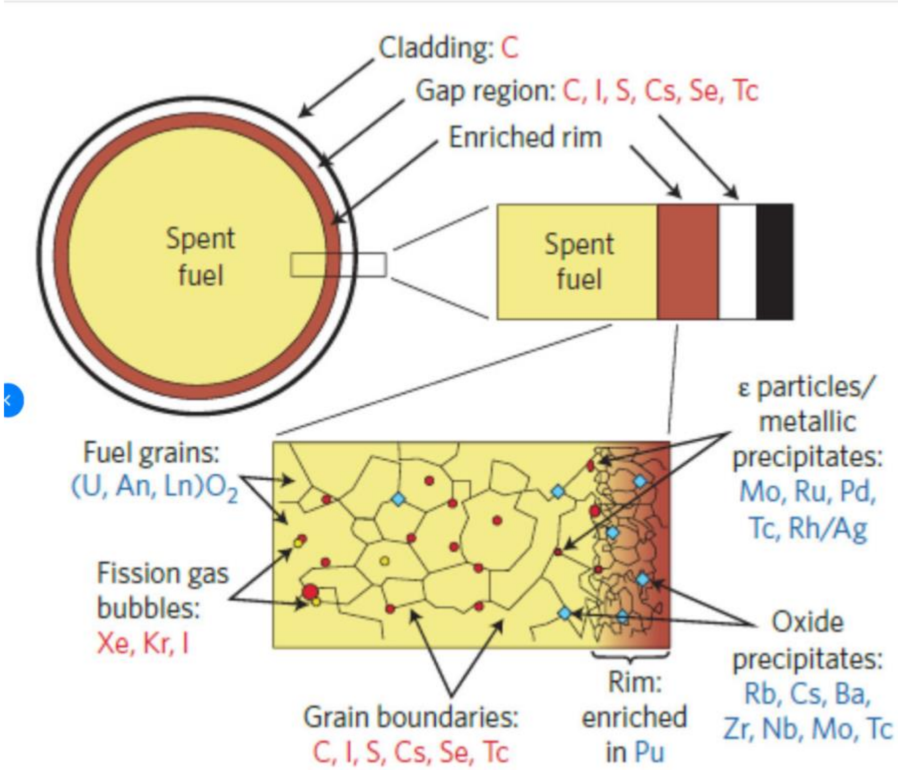
> 5. No imports or exports
> The import and export of nuclear wastes over public roads and bridges should be forbidden except in truly exceptional cases after full consultation with all whose lands and waters are being put at risk. In particular, the planned shipment of highly radioactive liquid from Chalk River to South Carolina should not be allowed because it can be down-blended and solidified on site at Chalk River. Transport of nuclear waste should be strictly limited and decided on a case-by-case basis with full consultation with all those affected.

Assessment of the transportation of used nuclear fuel over public roads, rail lines and bridges is necessary to address the legitimate concerns of Indigenous communities that are on the transportation routes or are adjacent to them.

(7) The repackaging of used nuclear fuel at the DGR site must be assessed

NWMO asserts that 5.9 million highly radioactive used nuclear fuel bundles will be transported to the DGR site. At that point they will be removed from their transport containers and repackaged in much more compact copper-coated containers for burial. It is known that damage to the fuel bundles – cracks, punctures, pinholes, or worse – will allow radioactive materials to escape from the bundle, causing contamination. Radioactive materials created during the fission process that are biologically hazardous are immediately releasable following fuel damage because they are in the gap between the cracked used fuel pellets and the metallic cladding. See the diagram below:



Schematic of spent nuclear fuel (SNF) microstructure and the distribution of fission products and minor actinides after fission. Reproduced with permission from Bruno J and Ewing R C 2006 Spent nuclear fuel Elements 6 343. Copyright 2006 Mineralogical Society of America.

Radiotoxic materials in the gap area are immediately releasable if the cladding is compromised; they include radioactive iodine-129 that concentrates in the thyroid gland, radioactive cesium-137 and cesium-135 that concentrate in the soft tissues and the meaty portions of animals, radioactive carbon-14 that freely exchanges with non-radioactive carbon atoms in organic molecules including DNA molecules, radioactive technetium-99 that can travel to all parts of the body. All of these can be released from the fuel bundle if the fuel cladding is penetrated in any way. If the damage reaches the pellet itself, then airborne aerosols of plutonium can be released from the rim of the pellet.

Cesium-137 has a 30-year half-life so half of the original inventory (when the fuel is discharged from the reactor) will have disintegrated by the time it reaches the DGR site, but there is still a great deal of this highly radioactive material left in the fuel. The other materials mentioned above will be virtually the same as when the fuel was freshly discharged because they all have extremely long half-lives. Long half-lives guarantee that if those radioactive poisons are released to the environment they will remain there for thousands or even millions of years, possibly in the food chain or the water.

Cesium-135 has a 3.5 million year half-life. Carbon-14 has a 5,700 year half-life. Iodine-129 has a 17-million-year half-life. Technetium-99 has a 210,000 year half-life. Plutonium-239 has a 24,400 year half-life. If released, all of them will remain in the environment for millennia. If they are incorporated into living things, they will be returned to the environment when those things die and their bodies decompose.

Given the dangers of handling and possibly damaging the used fuel bundles, IAAC should assess a simple alternative. Why not package the fuel bundles into the final burial containers BEFORE transporting them to the DGR site? The reactor sites have tools and experienced workers to do the job more efficiently and more safely than in a remote northern community with much more limited resources and staff. It could be less expensive and less hazardous to repackage the fuel just once instead of twice.

NWMO's proposed above-ground repackaging operation – and alternatives – must play an important role in assessing the overall environmental and health impact of the NWMO proposal.

(8) Providing useful and detailed information about the radioactive wastes

Used nuclear fuel bundles are merely the containers for a large variety of long-lived highly radioactive poisons that have been created inside the fuel as byproducts of nuclear fission. Yet the NWMO description of the project provides no information about the actual waste materials – not even the ones that are most likely to be released, such as iodine-139, cesium-137, cesium-135, carbon-14, or technetium-99, nor the ones that are regarded as particularly radiotoxic, such as isotopes of plutonium and americium; nor the ones that are most easily incorporated into the organic molecules of living things, such as radioactive hydrogen (i.e. tritium) and radioactive carbon (carbon-14).

NWMO must be required to provide a complete list of these radioactive poisons, most of which were never found in nature before 1940, and to describe the environmental behaviour of at least some of the most significant radionuclides in the event of accidental releases of these materials. In each case, NWMO should be required to discuss mitigation measures and cleanup measures in the event of accidental releases, as well as protective measures that people can take to avoid bodily contamination/

(9) Addressing the security problems related to plutonium

Every used nuclear fuel bundle contains human-made plutonium, which is usable as a nuclear weapons explosive. Plutonium is not found in nature in usable amounts, but it is mass-produced in all nuclear reactors that are fuelled with uranium. Used nuclear fuel is therefore subject to safeguards and routine inspections from the International Atomic Energy Agency (IAEA) to ensure that plutonium is not diverted for military use.

Since plutonium-239 (the most abundant isotope of plutonium) has a half-life of 24,400 years, the threat of diversion for military use is a multi-millennial problem. The question of security requirements for the short and the very long-term must be part of the assessment of NWMO's project, including the dangers of unauthorized retrieval of the buried waste at some future time following closure of the facility.

(10) Reprocessing of used nuclear fuel to extract plutonium

Although the current NWMO proposal does not include "reprocessing" of used nuclear fuel to extract plutonium from the waste before burial, NWMO has always included reprocessing as a possible option. Any currently available technology for the extraction of plutonium will also liberate all of the other radioactive waste elements from the fuel bundles, making reprocessing especially challenging in terms of environmental protection and worker safety, as well as very long-term health protection. The range of possible reprocessing options must therefore be fully described (including a discussion of the various "waste streams" arising from reprocessing). Environmental impacts must be discussed in detail during the impact assessment of NWMO's proposal.

(11) Justifying predictive models that are as yet unproven

There is no scientific principle that allows us to predict with any certainty the fate of buried high-level radioactive waste over millions of years. Geology is not a predictive science, but a descriptive science. It can tell us what has happened but not what will happen.

Part of the assessment must address the methods used by NWMO to attempt to validate their as yet unproven predictive models over such long time periods. In particular, NWMO should be required to address the uncertainties identified by a host of Earth scientists in such publications as Techniques for Determining Probabilities of Geologic Events and Processes, published by the International Association for Mathematical Geology. See www.ccnr.org/geology.html