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Disposal of high-level material in subduction zones – a rebuttal

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for the subductive waste disposal method[1]; baird-jr@shaw.ca

Disposal of nuclear materials in subduction zones has recently been eliminated from Britain's list[2] of waste management options. The method has also been screened from consideration by Canada's Nuclear Waste Management Organization[3] (NWMO). The reasons specified, in both instances, are herein questioned.

The expressed concerns are; this option would be seen as a form of sea disposal and hence would be prohibited by international conventions. Concerns have been expressed that waste might return to the surface environment via volcanic eruptions. There is a question of confidence in predicting the fate of wastes eliminated in subduction zones. Retrieval of the fuel after disposal in a subduction zone would be impossible and the option is not included in any national or international R&D programs.

The nuclear industry has from its inception attempted to downplay nuclear energy's proliferation risk and accordingly the fact the subductive waste disposal method is the only viable means to eliminating weapons materials excess to defence needs or nuclear weapons in total has been minimized.

The U.S. Congressional Research Service has identified space and placement deep beneath the ocean floor as the only locations where nuclear weapons materials can be rendered irretrievable[4].

In its 1995 Screening Process to Determine Reasonable Alternatives for Long-Term Storage and Disposition of Weapons-Usable Fissile Materials the U.S. Department of Energy determined that only 3 of the 23 options considered rated high for Environmental Safety and Health criteria. Sub Seabed disposal and deep borehole emplacement, both of which are elements of the subductive waste disposal method, were 2 the other was taking no action at all[5].

Equilibrium is rarely found in Nature. It is a prerequisite however for any nuclear waste repository. The heat generated by a repository would reorder the essential precondition of any geologic system in which a repository was placed.

F.W. Dickson questioned the wisdom of concentrating radioactive materials in small volumes of crustal rock. "Released energies near the surface from repositories would drive convective cells, similar to those from volcanic heat (Old Faithful Geyser in

Yellowstone National Park, Wyoming). Silicate liquid bodies formed at depths rise as diapirs and reaction cells.[6]"

Heat and water are the driving forces behind these reactions. Free water is rarely found in oceanic lithosphere older than 5 million years. Subduction zones are the coolest places on the planet. These conditions make the subducting oceanic crust the logical locations for a nuclear waste repository.

Legality

Subduction zones are usually associated with deep ocean trenches. The subductive waste disposal method places waste materials into waste repositories radiating from an access tunnel constructed into a subtending tectonic plate adjacent or as near as possible a subduction zone. The waste materials descend within the tectonic plate into the mantel of the Earth.

In 1993, the Contracting Parties to the London Convention, the United Nations treaty that regulates the dumping of wastes at sea, banned the dumping of all radioactive wastes from ships, aircraft, platforms and other man-made structures at sea. The status of sub-seabed disposal was ambiguous until 1996 when the Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, (the Protocol) extended the definition of "dumping" to include "any deliberate disposal or storage of wastes or other matter in the sea-bed and the subsoil thereof." Definition, 7, Article 1 of the Protocol states: "Sea" means all marine waters other than the internal waters of States, as well as the seabed and the subsoil thereof; it does not include sub-seabed repositories accessed only from land."

"While sub-seabed disposal of nuclear waste-filled canisters thrown from vessels apparently is regulated by the London Convention, and will certainly be regulated by the Protocol, sub-seabed disposal is not prohibited or regulated by the London Convention when accessed via land-based tunnels. Sweden has been practicing this method of sub-seabed disposal since 1988, when a repository for reactor wastes was opened sixty meters below the Baltic seabed. This project has been widely cited by politicians from other countries as a great example of solving the nuclear waste problem.

Because of Sweden's initiative, nuclear waste is already being deposited under the seabed. Other countries could follow Sweden's example and dispose of nuclear waste under the seabed via land-based tunnels. Special attention must be given to shore-accessed seabed burial of nuclear waste because current international coverage of this problem is extremely deficient. Neither the London Convention nor the Protocol regulates this activity because the waste is not dumped from the ocean, but from land. UNCLOS does not regulate this activity because it occurs outside the Area and within the national jurisdiction of Sweden."[7]

After an eleven year study by an international Seabed Working Group the Nuclear Energy Agency (NEA) concluded, "seabed disposal has the capability of meeting relevant safety criteria and should therefore be considered as a potentially viable option for the safe disposal of high-level and other long-live radioactive waste."[8]

"WTO" obligations require all member states to base their legislative measures on sound science, and to ensure they are no more trade-restrictive than necessary to achieve a legitimate regulatory goal.

Given the NEA declaration seabed disposal is "safe" the 1996 London Dumping Protocol was a violation of WTO member obligations.

Given the conventional wisdom it is apparent this option would only be acceptable in the current environment if a subduction zone could be accessed by means of a tunnel from land, as is possible west of the Brooks Peninsula of Vancouver Island.

Figure 1 shows the relationship between the North American, Explorer and Juan de Fuca plates adjacent Vancouver Island.

Figure1[9]

Most subduction zones are associated with deep ocean trenches. Figure 2 is a generalized interpretation of major blocks from density/susceptibility modeling of a line beginning on the Explorer plate, crossing northern Vancouver Island just below the Brooks Peninsula which is a 14-km finger of land jutting into the Pacific Ocean off the west coast of Vancouver Island. This model shows both the proximity of the subducting Explorer Crust to land as well as the shallow depth of this crust at a distance 50-70 kilometers from the western terminus of the line. Accessing the Explorer Crust at the depth show, from the Brooks Peninsula, could be accomplished with conventional tunneling techniques.

Figure 2[10]

Volcanism

Both CoRWM and Nirex have sited a Swiss Expert Group on Disposal Concepts for Radioactive Waste report[11], which in turn references a 1970 article published in Nature by Bostrom et al. as its authority for claiming waste might return to the surface environment via volcanic eruptions.

Subsequent to the 1970 Nature article it has been demonstrated, experimentally, subducted oceanic lithosphere is not likely to contribute to destructive margin magmas. Such hydrated crust must dehydrate at a depth of 80-100 kilometers in a subduction zone and release water into the overlying wedge of lithospheric mantle. Since the melting temperature of mantle peridotite is lowered by the addition of water, this causes melting of the mantle peridotite and is the most likely source of volcanic magmas.

Melting of subducted crust may occur however when very young - and therefore hot - seafloor is subducted (Defant and Drummond, 1990). This is unusual but the Explorer plate is composed of very young crust.[12]

Stern, R.J., 2001, outlines the Physics of subduction zones and the dynamics of volcanism associated with these regions. He differentiates subduction zones according to the age of the subducting lithosphere. Young lithosphere is inherently unstable, not only because the subduction of young, less dense, buoyant lithosphere becomes increasingly difficult, but because at some point the ridge and trench will meet and the convergent margin will become a transform margin.[13] The Explorer plate is typical of this type of subduction zone.

In contrast old lithosphere sinks easily beneath less dense asthenosphere but this, more conventional, type of subduction zone is always associated with deep trenches which preclude the accessing of a subducting plate by means of a tunnel from land (the only currently legal option).

Fate of wastes

Subduction of young lithosphere ends with the intersection of spreading ridge and trench, as is currently occurring where the Dellwood Knolls and Explorer Ridge meet the Cascadia Subduction Zone (CSZ) and transitions into the Queen Charlotte Fault.

Rohr et al. 1995 made a case the Explorer Plate is no longer subducting.[14] They interpreted a zone of seismicity cutting across the Explorer plate to represent the new Pacific-America plate boundary. Although there are problems with biases in earthquake locations offshore (seismographs only on the land side), there is little doubt that there is substantial seismicity within the Explorer plate. The Explorer plate must be breaking up. The evidence against the complete cut-off version of their model (i.e., new plate boundary takes all Pacific-America motion) is, (a) the northern end of the Juan de Fuca ridge would be cut off by such a new plate boundary, and that part of the ridge seems to be active (recent volcanics, black smokers etc), (b) the Pleisocene sediments along the northern Vancouver island continental slope (Explorer plate boundary) are strongly folded and faulted, similar to off the southern margin.

Probably the most conclusive evidence that the Explorer plate is still subducting is the recent (since Rohr et al.) work of Mazzotti, Stéphane et al., 2003[15]. There geodetic GPS measurements on northern Vancouver Island showed convergence shortening, similar to on southern Vancouver Island. Their most recent assessment is the existence of an independent Explorer micro-plate currently underthrusting beneath North America, at least up to Brooks Peninsula.

If Rohr is correct, a repository constructed in the Explorer plate adjacent the Brooks Peninsula would be no better or worse than Sweden’s sub-seabed repository at Forsmark. There would however be no potential for volcanic return of nuclear waste to the biosphere.

If the more recent assessment of Mazzotti et al. is correct, such a repository would be consistent with the state-of-the-art described in the subductive waste disposal method patents.

When one runs the Microsoft Bookshelf animation of continental drift forward 60 million years from today, the seabed adjacent the Brooks Peninsula migrates to the region of the mid-southern United States. On the basis of this visual, it is difficult to image the current region of the Explorer plate doing anything other than subducting over that period.

From the magnetic band study in Figure 6 it can be seen the triple point of the Explorer Plate is migrating north, and anything below that point will eventually be subducted. Everything north of the triple point is evolving into the strike-slip Queen Charlotte transform fault.

To the north of the Nootka fault, Mazzotti et al. measured a convergence rate (subduction rate) of 20-25 mm/yr which is about half the Cascadia Juan de Fuca plate convergence rate of 45 mm/yr south of Nootka Island. Further north of Brooks Peninsula, the motion becomes more complex in the Winona Basin transition zone as the strike-slip motion of the Queen Charlotte transform fault evolves.

With a convergence rate of 25 mm/yr it would take 8 million years for waste deposited at the CSZ to reach the volcanic zone 200 kilometres further inland. More than enough time to minimize the radiation hazard of any waste that might be melted at that time.

Figure 3 is an example of an aqueous convection cell adjacent an oceanic ridge where hot mantle materials rise and create new oceanic crust. The surface B consists of basaltic lava flows and pillow lavas: layer C below is made up of magma-filled cracks or dykes. And layer D of gabbro-peridotite. A large basaltic magma chamber is shown at the ridge. The crust cools by conductive heat flow and by driving seawater convection cells, which vent to the ocean near the ridge (E). The new crust moves away from the ridge and becomes sediment-covered (G). Fluid convection becomes confined in the basaltic layer beneath the impermeable sediments (F).

Figure 3.[16]

Hydrothermal convection is an efficient conductor of heat. As the temperature gradient decreases away from the ridge crest the circulation of water decreases. Hydrothermal circulation of seawater through the oceanic crust is an important process for only about five million years after crust formation. Most of the metamorphic alteration of mid-ocean ridge basalts takes place in the first one or two million years, after which water is locked up in hydrated form in the crust. Oceanic crust older than two million years is therefore the only accessible geology in which hydrothermal convection; and its potential to return radionuclides to the biosphere, is not likely to occur. This is particularly true of young shallow subduction zones, such as the Explorer plate, which do not typically undergo the bending-related faulting characteristic of older type subduction zones. Wastes deposited in oceanic crust adjacent the Brooks Pensinsula could not be mobilized until it reached a depth of approximately 100 kilometers in the subduction zone, which would take 8 million, unless the subduction process stopped in the meantime.

Figure 4 illustrates the kind of reaction cells described by (Dickson, 2000)[17] at a subduction zone where sediment covered ocean crust and lithosphere (about 100 km thick) descends back to the mantle near a trench environment (A). Sediments may be scraped off; adding to the continent, but some may be dragged back to the mantle. At depth (D) water released from the descending slab may trigger melting and the production of andesite melts (reaction cells), which rise to form volcanoes. The thermal flux may lead to crustal fusion and the creation of large granite plutons (B) which may be cooled by convecting groundwaters (C).

Figure 4[18]

Figure 5 is a computer-generated model of a temperature variation in a subduction zone, showing the depth of occurrence of processes important for the generation of destructive margin magmas. It shows that temperatures of close to 1000 C are necessary to produce the melting phase change plus the pressures existing at a depth of 100 kilometers.

A 1984 Nature article by a committee of The International Council of Scientific Unions concluded, “Data from trench environments clearly show that in most, the lithosphere cracks to from a horst and graben structure and that light sediments are carried down with the descending plate. Most trench environments are extremely cold and are characterized by the lowest thermal gradients on the planet, so that solution processes of waste or corrosion of containers will be minimal. Moreover, the total mass of fluid available for transport can be quantified, as the material is moving into essentially anyhydrous upper mantle.”[20]

Figure 5[19]

The committee also noted, “a repository could be breached by a meteoric impact. This subject tends to be ignored, but the chances of such an event may not be as small as some believe.” What they emphasized was that there is safety with depth.

On the same subject they concluded, “Appropriate mining technology for depths up to 4 km exists, and the 500-1,000-m depths commonly considered adequate require careful justification. They also concluded, “Stress levels are more predictable and more regular at great depths. Near the surface, unusual or unexpected results – from mining – are not uncommon.”

Gold mining at a depth of 5 km has recently been considered in South Africa.

The CSZ does not have a recognizable trench.[21]. This is most likely caused by the slow subduction action and the environmental conditions of the Pacific Northwest. Average rainfall in the Pacific Northwest is high and the deposition of erosional systems surpass the rate at which sediments are subducted. These sediments have a propensity to sequester any radionuclides that might escape a repository.

Most subduction zones have significant seismic activity. The slow rate of convergence of the Juan de Fuca-North American plates is attributed with the low frequency of seismic events.

Another contributing factor for the infrequency of seismic activity is the proximity of the spreading center to the subduction zone. Warm non-rigid oceanic crust is being subducted. The lack of rigidity of the crust contributes to a more plastic and conformable subduction plate. The maximum age of the Explorer plate according to the marine magnetic band study in Figure 6 is 4 Ma. As shown in Figure 7 the rate of heat flow from the mantle is significantly higher in young ocean floor than in the older type.

Figure 6[22]

The area in which would work would be performed either in the course of construction of a repository in the Explorer plate or during emplacement of the waste would be confined and amenable to localized cooling efforts. Conditions of work would be presumably no less onerous than on the moon. The writer has developed a proprietary passive cooling system that would further alleviate this problem. Workers could also be transported to and from work areas in air conditioned comfort.

Figure 7[23]

Toshiba Corporations' 10 megawatt nuclear battery would be an excellent power source for this application both to run automated tunnel boring machines (TBMs) and to operate air conditioning units in the work zone. Such a unit would ensure exhaust gases would not be introduced into the access or repository areas. Electrically operated TBMs would also ensure hydraulic fluids do not leak into the repository environment as would be inevitable if hydraulic power was used.

Retrieval

If necessary, long-term monitoring of waste disposed of by this method would be possible by maintaining the access tunnel for some time after constructing artificial barriers.

The proliferation of weapons of mass destruction and their means of delivery in conjunction with the spread of international terrorism is considered by some the pre-eminent threat to mankind. Others consider climate change to be that threat. The subductive waste disposal method addresses both.

James Lovelock, developer of the GAIA theory, has declared, “Nuclear is the only practical energy source that we could apply in time to offset the threat from accumulating greenhouse gases." In terms of the waste problem associated with nuclear, he stated, "There seems no sensible reason why nuclear waste should not be disposed of in the deep subducting regions of the ocean where tectonic forces draw all deposits down into the magma.[24]"

The need to prevent the spread of nuclear weapons has been evident from the first days of the nuclear era. In 1945, the United States, the United Kingdom, and Canada proposed the establishment of a United Nations Atomic Energy Commission for the purpose of "entirely eliminating the use of atomic energy for destructive purposes." The Baruch plan of 1946, offered by the United States, sought to forestall nuclear arms proliferation by placing all nuclear resources under international ownership and control.

The opportunity exists currently to revive that approach.

A recent adaptation of the Baruch plan was offered by the U.S. Baker/Cutler task force, which recommended the buying and removal as quickly as possible of all the nuclear weapons and weapons-usable material Russia is prepared to sell.

The Subductive Waste Disposal Method affords then the sole practical means to eliminating these materials and sequesters and eliminates, spent fuel and chemical or biological toxins equally as well. It is also a solution that can be implemented at a fraction of the cost of current approaches with a Canadian site providing the opportunity for the U.S. to reciprocate to Russia's disarmament, as that country will legitimately demand.

Environmentalists have recently been banning together to purchase habitats they wish to preserve. The purchase of global stocks of nuclear weapons materials would be a rational exercise in self-preservation.

Saying "recent events have made it clear that the nonproliferation regime is under growing stress," Mohamed ElBaradei recommended to the Fifty-Eighth Regular Session of the United Nations General Assembly limiting the processing and production of nuclear materials that can be used for bombs and placing facilities under international control.

In presenting the International Atomic Energy Agency Director General's annual report to the General Assembly, Dr. El Baradei said, "We should equally consider multinational approaches to the management and disposal of spent fuel and radioactive waste. Over 50 countries currently have spent fuel stored in temporary locations, awaiting reprocessing or disposal. Not all countries have the appropriate geological conditions for such disposal - and, for many countries with small nuclear programmes, the financial and human resources required for the construction and operation of a geological disposal facility are daunting." he advised.

“What is to be done with the spent fuel? Here I have a specific and emphatic recommendation-- the creation of competitive, commercial, mined geologic repositories to be certified by the IAEA for spent fuel and nuclear waste; the acceptable forms of spent fuel and nuclear waste would need also to be certified by IAEA. In the era of globalization, it is ridiculous to insist that Switzerland or Belgium or England each do the research and development and find within its limited territory a site for the geologic disposal of nuclear waste," Richard L. Garwin, Philip D. Reed Senior Fellow for Science and Technology, Council on Foreign Relations recommended in an address entitled "Can the World Do Without Nuclear Power? Can the World Live With Nuclear Power?" to the Nuclear Control Institute, April 9, 2001. "Ultimately, disposal under the deep seabed may be the solution, with continued surveillance to avoid poaching to obtain long-decayed spent fuel for its plutonium content." he added.

Irretrievability of spent nuclear fuel is an asset, rather than the liability NWMO earlier claimed, given the current conjunction of terrorism with vast arrays of bomb-grade materials and high-level waste lying poorly protect around the world waiting to be bought or stolen.

The G8 has committed to spending $20 billion in Russia to fund disarmament projects in that country. Unfortunately no solution to the proliferation problem is to be found there. It does exist however off the British Columbia coast as Russia's leading expert in the field concurs.

Velikhov, Yevgeny, noted "out of 14 versions of liquidating nuclear waste in some countries, suggested by researchers now, only three can be examined dead serious and even in this case with a great share of doubt and in the most distant future.

Radioactive waste can be shipped to the sun by space freight ferries, to put into pits of the Antarctic ice cap and to place it into Earth's crust at great depths so that it can melt in the plasma of the earth later."[25].

The latter solution is the subductive waste disposal method.

Proprietary improvements have been developed for this method that would expedite the elimination of nuclear weapons materials and would ensure the material could never be reconstituted in bombs.

The English Channel "Chunnel", the closest analogy to this solution, is actually three tunnels of a combined length of 95 miles and was completed at a cost of $15 billion.

The U.S. Yucca Mountain repository currently consists of a 5 mile tunnel, which is anticipated to be extended 35 miles to accept America's waste at a cost approaching $60 billion. Close to $30 billion of this is earmarked for the repository alone. Much of this increased cost results from the necessity for expensive engineered barriers because Yucca Mountain is incapable of sequestering radionuclides geologically. Nor, according to Dickson, can any existing method. In addition the cost for disposing of 100 tons of Russian and American plutonium, less than half of the 260 tons of weapons plutonium that has been produced worldwide for weapons, not including separate plutonium from commercial operations, has been estimated at over $6 billion.

An embodiment of this invention would require two tunnels, one for access and the other for ventilation, each of length of 30 miles, to reach the preferred geology off the Brooks Peninsula of Vancouver Island. Add 35 miles for the repository and you have the combined length of the Chunnel at half the cost of Yucca Mountain. Add another 35 miles of tunnel and an international repository with a capacity of 140,000 metric tons is created with intrinsic economies of scale.

The Chunnel was expected to cost $6.2 billion but finished at $15 billion because engineers were working with completely new technology. No one had dug tunnels that deep or that long before and cost overruns, in large part, were due to financing costs. This project would benefit from both record low interest costs and existing tunneling expertise.

Dr. Burton Richter, Noble laureate in Physics, has stated with respect to nuclear waste, "It can be done if it is done right and the public is correct in their concern that it be done so. If we would dump all this stuff in subduction zones in the ocean, or if we would bury it half a kilometer deep in the deep sediments of the ocean floor, no one would ever have to worry about it."[26]

Five circumstances currently mitigate in favour of a Canadian resolution to this problem:

1. As a major supplier of both uranium and reactors to the global market Canada has an obligation to provide for the by-products and to do everything possible to prevent proliferation.
2. There is a growing recognition and discomfort amongst Canadians with our country's steadily eroding international influence as exemplified by the recent Canadian Time magazine cover and feature article, "Would Anyone Notice If Canada disappeared? – The nation's influence in the world is shrinking. How-and why-it should be rebuilt." (There is no better way than for this country to walk its own talk with respect to global security and the environment.)
3. Vancouver Island is amongst the most underperforming regions economically in this country.
4. Transportation makes the Subductive Waste Disposal Method the best option for an international repository as is the practical solution for this continent and the only viable alternative for many countries. In the September 1990, Special Issue, "Energy for Planet Earth," of the Scientific American, Wolf Hafele, in an article "Energy from Nuclear Power," relates such a scenario located on an island or peninsula. Preferably under the auspices of an international institution. He states, "International storage facilities offer several advantages. They encourage the development of global institutions that would be immune to national politics. Such facilities would allow the nuclear-power industry the time it needs to develop scientific, technological and institutional final waste disposal methods. Access to these facilities would give countries that steered clear of nuclear power because of the waste issue a chance to develop nuclear energy. The sites could also play a key role in disassembling nuclear weapons and ensuring non-proliferation of nuclear material."[27] This is in effect the Baruch plan revisited.

5. Many countries consider international institutions the best offset to U.S. unilateralism.

A few cold war submarines might best be diverted to the usage of transporting spent fuel or weapons material from the East Coast of North America, Europe or the Baltic to a Pacific Coast repository via the Northwest Passage because cross country transportation is touted as any mid continent repository's principal drawback. Submarines operate beneath the weather, which is the principal cause of accidents at sea. Submarines also operate beyond the reach of terrorists.

The Subductive Waste Disposal Method is the final waste disposal method Hafele affirmed is still being sought and is the logical extrapolation of the intermediate fuel element storage/reprocessing plant scenario he described though the once through cycle, for security reasons, is preferable.

Sixty years into the nuclear era, despite global expenditures of billions, not a single ounce of high-level nuclear material has been permanently isolated. A dozen years after the end of the Cold War, not an ounce of plutonium has been destroyed. Dr. Garwin is right, the market can do it better, faster and cheaper and that is precisely what is required. As former U.S. Senator Nunn articulates it, "the new arms race is terrorist racing to acquire weapons of mass destruction, while the rest of us have to run even faster to prevent such an eventuality."

Where spent fuel disposition is resisted by the public, as burning plutonium in commercial reactors, its elimination in conjunction with weapons material becomes a saleable proposition.

Intellectual integrity is critical to the resolution of this problem for which the public will accept nothing less than the state-of-the-art.

The precedent for this solution has been set. At the 1996 G-8 Moscow summit on nuclear safety and security Prime Minister Chrétien agreed in principle to consider using U.S. and Russian weapons-grade plutonium as fuel in Canadian reactors. The rationale was Canada is committed to, and strongly advocates, world nuclear disarmament. Eliminating the risk of theft and proliferation posed by plutonium from nuclear weapons helps mankind to reach this goal. Other countries view Canada as a safe and responsible country that can act as a respected third party in converting both Russian and U.S. weapons-grade plutonium.

The same rationale applies to an international repository in which spent fuel, which can either be harvested for plutonium or used in a dirty bomb, or nuclear weapons materials will be eliminated directly, rather than first being irradiated before being placed in a Canadian repository, as would have been the case had the Prime Minister's offer been taken up.

The anticipated savings this proposal affords over a Yucca Mountain repository would provide a substantial down payment on the global inventory of nuclear weapons materials plus the means to safely transport them to the proposed repository.

The Harvard Project on Managing the Atom report, "Preventing Nuclear Terrorism, A Progess Update" concluded with the declaration, "The terrorists have made clear that they want nuclear weapons, and are working to get them. A continuing stream of attacks and intelligence analyses makes clear that al Qaeda is regrouping, recruiting and training new operatives, and still seeking to carry out catastrophic attacks on the United States and other countries."[28]

President Bush has eloquently warned that "history will judge harshly those who saw this coming danger but failed to act." The question remains: on the day after a terrorist nuclear attack, what will we wish we had done to prevent it? And why aren't we doing that now?"

A poll conducted by the Angus Reid Group in February 1998 showed 93 percent of Canadians support the abolition of nuclear weapons, and 92 percent believe the Canadian government should take the lead on this initiative as it did with the ban on anti-personnel landmines.

In an April 28, 2005 submission to the Canadian Nuclear Waste Management Organization (NWMO), F.P. Ottensmeyer, PhD, Fellow of the Royal Society of Canada, Professor Emeritus, Department of Medical Biophysics University of Toronto, proposed the subducting Juan de Fuca plate adjacent Vancouver Island as the appropriate location for eliminating the global stockpile of spent nuclear fuel. He said, "It would be Canadian, and we could lead the world to a safe way of nuclear waste disposal, providing the solution to the real bottleneck to the safe use of nuclear energy."[29]

International Programs

The Geological Survey of Japan is currently undertaking the JUDGE project which it recognizes as important from both a scientific and societal point of view. "The JUDGE project is aimed at understanding the earth's interior, last unexplored region of our planet earth, by conducting ultra-deep continental scientific drilling and multi-purpose scientific observation on subduction zones. This project provides us with fundamental knowledge that is indispensable for;

(1) reducing the damage of geologic hazard such as earthquake,
(2) exploration for new energy resources,
(3) managing deep ground-water and mineral resources, and
(4) geologic disposal of radioactive or toxic waste.

Besides, it will give incentive for innovation of new technology."[30]

The U.S. Congressional Research Service acknowledges that, "among the primary long-term disposal alternatives to geologic repositories are disposal in deep ocean trenches and transport into space, neither of which is currently being studied by DOE."[31]

Fyfe, W.F., et al. 1984, concluded, "Disposal in subduction trenches and ocean sediments deserves more attention."

W.S. Fyfe, regarded as one of Canada's leading scientists, said in a 1999 article, "The isolation of nuclear wastes for at least thousands of years is an urgent world problem. It is an international problem, for in many nations with such wastes their geology is not suitable for long-term isolation.

A lead geo-question involves which are the best host rocks, with guaranteed long-term low permeability and the best ion-exchange, redox systems for the capture, retention, of the most dangerous nuclides. In general mud rocks on land or the sea floor must be considered. . .

Where on earth is the best place?

I think the first consideration of this question is that national boundaries are of no interest given the time requirements of isolation of the order of a million years. It is also essential that for any chosen site, it must be subject to open study by all the required experts at any time. There has been a tendency for nations to feel they must put their wastes in their own territory. This restriction could lead to disasters."[32]

Advantages of this method

- Hazardous wastes can be disposed of in isolation from the biosphere;
- Wastes can inexorably be removed over time from the vicinity of the biosphere, rather than remaining dormant and contiguous, as in conventional geologic disposal, where a chance calamity, the likelihood increasing over time, might cause the hazard to reemerge;
- Wastes previously considered unrecycleable can be reclaimed in the earth's mantle;
- Waste is removed from the biosphere faster than it can return,
- Weapons-grade materials can be rendered inaccessible upon closure of the repository access;
- Waste would be immobilized for at least 8 million years;
- Nuclear waste would be deposited twice as deep in the crust of the earth as the proposed buffer between the waste and the surface at most geologic disposal sites;
- The thickness of buffer between the waste and biosphere would increase annually by 2.5centimeters;
- An overlaying buffer of 2 kilometers of water would further separate nuclear waste from mankind for the initial period of greatest radiological risk and would ensure that the waste could only be got at via the access which could be readily secured;

- Any waste that might escape a repository constructed in accordance with the method would be bound-up in the overlaying buffer of turbidite sediments that, it has been demonstrated, have a propensity to cling to radionuclides that have fallen onto the ocean floor as a result of accidents or atmospheric testing of nuclear weapons;
- The ocean has enormous dilution capacity should the containment system prematurely fail and allow substantial releases of radionuclides to the ocean floor;
- The method is ideally suited for the establishment of international cooperative activities;
- Over the centuries the subduction process would deform a backfilled and sealed access, ensuring perpetual isolation of the relegated material;
- The subducting plate is a renewable resource and is replenished continuously at its originating oceanic ridge;
- Ground water could not be contaminated because of waste containers being breached by radiolysis or otherwise as is a inevitable at any continental geologic disposal site;
- The temperature moderating effect of the ocean on the seabed in conjunction with the fact oceanic lithosphere contains one fifth the naturally occurring radiogenic substances found in continental lithosphere makes the method a superior dissipater of the thermal heat of high-level radioactive waste;
- Wastes deposited in the subduction zone would not render overlaying property useless in perpetuity;
- Wastes deposited on land would be more vulnerable to sabotage, an act of war, glaciation or impact from a celestial body than waste deposited within an oceanic subduction zone;
- There are volcanic risks, amongst others, associated with the United States Energy Department's Yucca Mountain site;
- The subduction zone is naturally predestined for destruction; and
- The subduction zone is accessible by water which is the safest means of transporting waste to a disposal site.

Conclusion

A history of secrecy has been the hallmark of atomic activities with the result the public are sceptical of any information that comes from those paid by, or associated with, the government or the nuclear industry.

The recent Canadian Policy Research Networks' Citizens' Dialogue on the Long-term Management of Used Nuclear Fuel found the public doesn't trust government, industry or existing regulators with the job of disposing of nuclear waste.

Britain has had similar experiences as was reported in the New Scientist editorial, How not to deal with nuclear waste. "In recent decades, UK policy on nuclear waste has swung between highly secret and scientific to nakedly politicised - there are still lessons to learn.

It would be difficult to think up a worse way of deciding where to put your nuclear waste. First, conduct the process in secret: lock the project's scientists behind closed doors and do not allow them to publish to their peers. Then, abandon science as a way to select suitable sites and choose instead a politically convenient location near a nuclear plant.

That, in essence, is what the UK did in the 1980s and 1990s when it chose deep rocks beneath the sprawling nuclear complex at Sellafield in north-west England as the preferred destination for its radioactive waste." [33]

After spending $700 million and decades of research NWMO has proposed another 60 years of study and the spending of unspecified millions more before construction of a deep repository and ancillary facilities in Canada will even be considered.

Geoffrey Lean, Environment Editor for The Independent, reported June 12, 2005, "Secret plans to postpone solving Britain's nuclear waste crisis for up to 1,000 years are being drawn up by the nuclear industry."[34]

If these organizations cannot immediately solve this problem, why would they libel what K.R. Rao has referred to as the state-of-the-art solution[35].

Part of the answer lays in Charles Hollister's assessment of why the U.S. Department of Energy killed the sub-seabed research program. "It was a clear case of 'not invented here.'''[36]

The rest has been exposed by the State of Nevada in its 2005 Chronology of Selected Yucca Mountain Project Emails.[37]

In 1996 the Department of Energy (DOE) discovered the Chlorine isotope (Cl-36) deep within Yucca Mountain. This could only have come from nuclear weapon testing in the atmosphere. They also discovered much more water in the Mountain than had been expected, and that it flowed much faster than had been previously estimated. These findings undercut the original assumptions for picking the site and made NRC licensing unlikely. "According to the law—the 1982 Nuclear Waste Policy Act—in the event of adverse findings regarding the site DOE was supposed to return to Congress with the bad news. This, however, was not anything that the DOE Yucca Mountain bureaucracy or its major contractor ever seems to have considered, for it would have meant killing their golden goose. In short, the project had taken on a life of its own."

In excess of 8 billion tax dollars have been pocketed in the U.S. and in every one of the other 50 countries faced with the problem of nuclear waste the "life of its own phenomena" has been repeated.

Instead of going back to square one the DOE staff scrambled for ways to keep the project alive. It shifted focus from trying to demonstrate the geologic adequacy of the mountain to a major reliance on the ability of the waste package to keep water away from the waste. To make the new approach look legal, DOE threw out the site selection guidelines that been in existence since 1984, which the site could not pass.

“Even with the change in strategy emphasizing packages, DOE still had the problem of how to meet radiation dose standards once the packages failed, even though they had pushed that off into the distant future. Because the site was so poor, no matter how DOE played with the computer codes, the peak dose after package failure was still too high to meet Environmental Protection Agency (EPA) standards. Nuclear Regulatory Commission (NRC) and EPA came to DOE’s rescue by limiting the period of regulatory compliance to 10,000 years, and thus allowing DOE to meet the radiation dose standard using any combination of environment and package. This opened the door to DOE qualifying for a license on the basis of its claimed corrosion-resistant packages alone. If they could get NRC to go along with the notion that the packages would last 10,000 years, they would never have to deal with the peak dose or the site geology.”

July 2004, the U.S. Court of Appeals found the 10,000-year requirement was illegal because it is inconsistent with the 1995 recommendations of the National Academy of Sciences.

In March 2005 DOE announced that certain USGS employees may have falsified work on Yucca Mountain.

These events have placed the U.S. repository program in jeopardy.

Perhaps it is time the institutions currently in charge of nuclear wastes admit, (a) they are pursuing the wrong solution; (b) they have lost all credibility. They have long since devoted themselves more to protecting their own turf than results and have thrown up every obstacle available to the only viable solution that has been presented.

In fallaciously undercutting this alternative, the existing agencies serve no one’s interest but their own.

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