Cuttler & Associates Inc.

Submission of Comments to

Nuclear Waste Management Organization regarding the first NWMO Discussion Document, titled:

Asking the Right Questions?
The Future Management of Canada's Used Nuclear Fuel

January 28, 2004

Prepared by

Jerry M. Cuttler
Cuttler & Associates Inc.
jerrycuttler@rogers.com

1781 Medallion Court, Mississauga, Ontario, L5J 2L6, Canada, Tel: 416 837 8865, Fax: 905 855 0399

INTRODUCTION

In late 2003, the Nuclear Waste Management Organization (NWMO) issued its first discussion document (DD1) as part of its study of approaches for the long-term management of Canada's used nuclear fuel. The purpose of DD1 is to invite comment on the issues to be raised and the questions to be asked, as the study moves forward.

This is a very commendable process, and those who conceived it are to be congratulated.

In response to this invitation, Cuttler & Associates Inc. has prepared this submission of comments to bring NWMO attention to some very important considerations that were not identified in DD1. The author requests that they be addressed in the NWMO study.

WE HAVE ENTERED A NEW WORLD

It is important to recognize that the world is constantly changing and that all living organisms endeavour to adapt to the changes in order to survive. Approximately 60 years ago, with the discovery of nuclear fission, we entered the atomic age. The initial driving force was the urgent development of weapons to end World War II and provide defensive deterrence. Subsequently, the release of nuclear energy was applied for the propulsion of submarines and other naval vessels. Then, peaceful uses appeared. As pointed out in DD1, the generation of electricity is a very common application with approximately 440 nuclear power plants, worldwide. Process heat from nuclear energy has been employed in Canada for heavy water production and is being considered for the production of oil from the Athabasca tar sands. Nuclear energy is being used in Europe for hot water district heating of homes and could also be employed for desalinating seawater and propelling merchant ships.

WE OUGHT TO KEEP NUCLEAR HAZARDS IN PERSPECTIVE

DD1 states (on page 7) that used nuclear fuel is very dangerous to humans and the environment if it is not properly managed. This, of course, is true for many other fuels, such as propane and liquid methane (and for chemicals, such as chlorine). In future NWMO discussion documents, it is important to mention these other fuels and the associated safety regulations, to keep the hazards in perspective.

Public concerns regarding used CANDU fuel are about potential exposures to radiation from gradual leakage of small amounts of radioactivity from containers after many centuries of storage or disposal. Such releases would expose individuals to very low doses or very low dose rates of ionizing radiation, in excess of natural background radiation. It is very important that the NWMO inform the public that low doses or low dose rates of ionizing radiation produce biopositive effects because they actually increase the activity of natural defense mechanisms in all living organisms, even in those individuals who are radiation sensitive and cancer prone.[Ψ] These increased protective activities are beneficial because they improve health. On the other

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[Ψ] CUTTLER JM, POLLYCOVE M. Can Cancer be Treated with Low Doses of Radiation? *J Am Phys Surg* **8**(4):108 (2003)

hand, high acute doses (more than 0.3 Gy∴) or high chronic dose rates (more than 10 Gy/year) of radiation are harmful because they decrease the activity of natural defense mechanisms. This phenomenon, known as the *adaptive response*, is gaining broad acceptance in the scientific community, and Canadian scientists are world leaders in this field of study. Potential radiation exposures to the public from containers of radioactivity after long-term storage are many orders of magnitude below the range of harm. There is no scientific basis for undue public concern about the storage of used CANDU fuel.

HAS THE PROBLEM BEEN DESCRIBED CORRECTLY?

Questionable assumptions are being made in formulating the problem. The fuel that is removed from CANDU reactors has been designated as "nuclear waste". But are we really thinking about future generations—our grandchildren and the growing population of Canada? Table 2.4 of DD1 indicates that fresh fuel contains 0.72 % U-235, of which two-thirds is fissioned in a CANDU to release 70 % of the energy to generate electricity. Only 0.70 % of the U-238 is employed to produce the remaining 30 % of the energy. More than 99 % of the used fuel is material that could be fissioned by spallation neutrons, which can be produced by high-energy accelerators developed in the 1960s. Accelerator-driven nuclear power plants are not economical today because uranium is plentiful. However, such plants will be built by future generations when mined uranium becomes scarce. The used CANDU fuel is a very large and very important source of energy for our grandchildren. Therefore, used fuel should not be labelled nuclear waste, and future NWMO discussion documents should acknowledge the enormous amount of energy remaining in the used fuel, which will likely be recycled by future generations, for many centuries.

Canadians should make provision for this recycling of used CANDU fuel by storing it at existing nuclear sites where this valuable resource can be accounted for and protected. The definition of nuclear waste should be changed to be the radionuclides remaining after extensive fission and transmutation of recycled uranium in the advanced nuclear power plants that will be built by our descendents. Much of the long-lived radioactivity, which is of concern, will be transformed into relatively short-lived radionuclides in such plants.

Are we perhaps naïve in thinking that future generations will somehow not be able to deal with the used CANDU fuel resource we are leaving for them? We need only look back at what energy technologies our grandfathers had and used, and compare that with what we know and use, in order to imagine what our grandchildren will know and use. Is it wise to use precious funds and energy resources to transport the used fuel to a remote site and perhaps bury it deep in granite? Would this not impose a great *recovery* burden on future generations? Would it not be better to use some of these funds to employ young Canadians in the research and development of the technologies that would allow them to recycle used CANDU fuel and to isolate the real wastes? Other countries will certainly be engaged in this activity. Canadians have past and current experience in separating radionuclides following fission of uranium, and our future generations should continue to develop improved technologies for managing the radioactive waste remaining following recycling of used CANDU fuel. The cost of recycling used CANDU fuel and isolating the real waste will be covered by the sale of the energy to be released from this used fuel.

∴ A dose of one gray (Gy) deposits one joule of radiation energy into one kilogram of tissue.

R&D programs to enable future recycling of used CANDU fuel and isolation of the real waste would have significant, positive socio-economic effects on the way of life of the communities that host these programs. Communities, including those of aboriginal peoples, who are interested in participating in the economic benefits, could volunteer to be hosts. Proper environmental assessment would, of course, be carried out prior to selecting sites for such programs. Funding to start already exists. Allocations have been set aside by the CANDU owners to manage used fuel.

COMPLEX ISSUES

Reference is made in DD1 page 10 to the complex set of ethical, technical and related public policy issues involved in managing used nuclear fuel over the long term. The issues may not be as complex and difficult as anticipated if the facts are presented; the stakeholders are identified; the myths are identified, and the real benefits are put in perspective with the potential hazards that people are concerned about.

As explained earlier, the risk of exposing people to harmful doses of radiation has been greatly exaggerated. Low doses of radiation are not harmful; they are beneficial. Potential exposures will be many orders of magnitude below the level where harmful effects could occur.

The number of used fuel bundles created each year (DD1 page 11) appears to be a large number and a significant storage problem. To put this in perspective, the NWMO should also point out that just one fuel bundle provides the electricity used by an average home for about 100 years. Although the number of bundles is large, the volume required to store this material is not very large, as pointed out in DD1 page 25. To put this small volume in perspective, the NWMO should describe the volume of solid or liquid fossil fuels that we would need to burn for the same amount of energy. The issue of the *release* of the products of fossil fuel combustion (and their toxicity and radioactivity) should also be mentioned in this context.

DD1 page 13 refers to AECL and CANDU owners as *nuclear waste producers*. This term conveys negative images; it is not an appropriate way to label these organizations. Generally, all organizations produce waste. A large fraction of the naturally occurring chemical elements are, in fact, radioactive (NORM), and living organisms cannot distinguish between radiation from NORM and radiation from human-made radioactive material. Companies that burn coal and other fossil fuels release large amounts of radioactive material to the atmosphere and the Earth's surface, while AECL and CANDU owners carefully store their radioactive materials.

The NWMO, in future documents, should recognize the existence of all the stakeholders in this used fuel management debate. These include ideologically driven organizations that advocate the phase-out of all nuclear technologies due to concerns about weapons proliferation, regardless of measures taken to safeguard used fuel. There are stakeholders who, for ideological reasons, advocate extreme energy conservation to limit human population growth. Other stakeholders include suppliers of energy sources and technologies, such as fossil fuels, windmills, solar cells, who are concerned about the competition from nuclear energy. They also have a vital interest in the creation of complex issues and the exaggeration of concerns that would make the nuclear energy option economically uncompetitive. Synergies between some of the stakeholders are

possible. The issues and concerns, in turn, create barriers to our access to an enormous and very important supply of low cost, pollution-free energy. To reach a wise resolution, we must identify and separate the myths from the facts—the ideology from the science.

TIMETABLE FOR CARRYING OUT THE APPROACH

There is no great urgency to start fuel recycling in Canada because there is an adequate supply of low cost uranium. Although, the used CANDU fuel is being stored safely in shielded containers, it is possible estimate when a shortage of space will occur at Pickering NGS. A more compact dry storage design would delay this eventuality, but at some time it will be necessary to transfer used fuel containers to the larger Darlington or Bruce nuclear site or to a new nuclear site that would accommodate an accelerator-driven nuclear power plant to recycle the used fuel.

A publicly accepted solution to the issue of how used fuel will be managed is needed because questions have been raised by stakeholders about the method by which we will manage our radioactive wastes in the long term. These questions must be answered *now* to the satisfaction of most Canadians because the lack of broad public acceptance of any solution is a barrier to the continuation and the expansion of Canada's nuclear energy program. It is also a barrier to the processing of wastes from legacy nuclear programs and wastes from the very important production of radioisotopes used in medicine and in industry. Behind these questions is the public's concern about the health hazards of radiation, and all the waste management methods will have to address this concern.

The argument will be made that each method involves some release of radioactivity, however small, at some time in the future and that this release will expose living organisms (including humans) to a greater amount of radiation than they would otherwise receive naturally from the environment. Use of the linear no-threshold hypothesis (LNTH) of radiation carcinogenesis and congenital malformations results in the notion that any additional exposure imposes an additional health risk to future generations of living organisms. This leads to the ethical question, "Is the benefit of low-cost, pollution-free nuclear energy for present generations justifiable in light of an additional health risk to future generations?"

In this submission, it is pointed out that *the LNTH is invalid* for biological organisms. Low doses of radiation are actually beneficial because they increase the activity of their damage-control biosystems. Future generations may receive additional exposures from radioactive waste, but they will be lower than or similar to natural exposures, which are well below the level at which harmful health effects begin to occur. The issue is therefore moot—of no practical significance.

If the public accepts this idea, the immediate social concern will be addressed. Implementation of the method of managing used fuel and other nuclear wastes can be carried out to a timetable that is based on our actual needs. Long-lived radioactive wastes from isotope production and from legacy programs should be processed into a dry form and stored together with used CANDU fuel. Future generations will transmute and process these long-lived wastes in accelerator-driven reactors, when they recycle used fuel.