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Ms. Elizabeth Dowdeswell, President
Nuclear Waste Management Organization
49 Jackes Ave., First Floor
Toronto, Ont.
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Dear Ms. Dowdeswell:

As a retired geologist and manager with the Geological Survey of Canada for over 30 years I read with interest your letter of 14 Oct. 03 to the editor, Ottawa Citizen, regarding the Nuclear Waste Management Organization. In my current capacity as a scientist emeritus with the Geological Survey since my retirement in 1993 I have had continuing contact with Natural Resources Canada. Your letter to the Ottawa Citizen, however, was the first indication to me that the Department had renewed its interest in the management of Canada's nuclear waste. It is, of course, quite possible that I was simply unaware of any previous publicity on this matter.

During my service as a Division Director with the Geological Survey from 1974-1987 one of my responsibilities was the management of the Nuclear Fuel Waste Management Program. During that time Energy Mines and Resources (now NRCan) was actively involved with Atomic Energy Canada Limited, Whiteshell Nuclear Research Establishment (WNRE) in the evaluation of the potential for the use of igneous rock of the Canadian Shield as a medium for the disposal of spent nuclear fuel. My further involvement with nuclear waste matters occurred following my retirement when I served on a part time basis as a Senior Science Advisor to the Secretariat of the Siting Task Force for Low Level Radioactive Waste Management. The Secretariat and the Task Force were activities of Energy Mines and Resources aimed at providing a solution to the problem of uranium refinery wastes that had accumulated over many years at Port Hope, Ont. and in the surrounding area.

My previous involvement with nuclear fuel waste management research and issues enables me to appreciate a.) the magnitude of the task that has been assigned to NWMO and b.) an awareness of the great difficulties to be overcome in obtaining public acceptance of almost any form of solution to the long term management of nuclear waste. It is from this background that I am providing a number of comments and observations on nuclear waste management that may be of some interest to your organization:

1.) Igneous rock types were chosen by Canadians in the early 70's as an alternative to bedded salt which was then the rock type of choice for the Americans. The American interest in salt declined after strong public opposition to the use of salt was experienced in Kansas where salt deposits had been penetrated by petroleum exploration boreholes of which record of location had been lost.

EMR undertook in the early 1970's a review of the occurrence of salt in Canada but its

location in the Maritimes, Ontario, Saskatchewan and Alberta was not conducive for nuclear waste disposal purposes.

2.) The Canadian Program focussed upon the study of various igneous rock types near Ottawa, Deep River, Atikokan and Massey in Ontario and at Pinawa, Manitoba. A number of these field studies encountered strong public opposition even though these were for the purpose only of evaluating rock characteristics, groundwater conditions and developing exploration techniques rather than for site selection. As a result of this opposition the field program became much restricted and was latterly confined to AECL properties at Chalk River, Ont. and Pinawa, Man. The program essentially culminated with the development by AECL (WNRE) of the Underground Research Laboratory located about 10 km north of Pinawa, Man. This facility provided the opportunity, inter alia, to develop excavation techniques designed to minimize fracturing peripheral to the shaft, assess the physical and chemical properties of intact igneous rock and to assess the characteristics of groundwater flow at depth within an element of the Canadian Shield.

The Nuclear Fuel Waste Management Program (NFWMP) involved the expenditure of many millions of dollars and produced a vast array of scientific and technical reports. A major series of these reports, designated as AECL Technical Records, are contained in the library of the Geological Survey of Canada in Ottawa and are also, no doubt, available from the scientific documents office of AECL at Chalk River. Further, reports on the program are contained in the proceedings of a number of international conferences on nuclear waste management.

In addition, the program had the benefit of an independent Technical Advisory Committee (TAC) composed of well qualified senior level academic staff. Annual overview reports by TAC available to the public were produced during the period 1979 - 1996. The committee disbanded in 1996 following submission of documentation for environmental assessment. In its final report (TAC-15) the committee noted that "a multibarrier system can be designed to meet the objectives of long-term safety to humans and the environment, and to be appropriate for siting in the Canadian Shield". It would seem that the environmental assessment review panel did not share this view.

In addition and in parallel with the Canadian NFWMP, work on nuclear fuel waste management was being undertaken in the United States, United Kingdom, France, Sweden, Switzerland, Germany, Japan and in other countries as well as by the International Atomic Energy Agency in Vienna. This international effort further added to the vast volume of literature on the subject. Most of this literature is of a scientific and technical nature and is thus of little direct interest to the public. There is, however, no shortage of information produced by AECL and other agencies designed to inform the public of nuclear waste management issues.

3.) The NFWMP was essentially a top down driven program aimed at finding a suitable (not necessarily "the best") site that could be developed for permanent disposal of nuclear fuel waste. It was assumed that such a site would have clearly evident merits and would readily receive public acceptance. Such an assumption, in spite of concerted efforts to inform the public of nuclear waste management issues and of the rationale for the geological disposal concept, obviously did not give full credit to the power of the not-in-

my-back-yard (NIMBY) principle and the very strong opposition of much of the public to anything nuclear.

4.) The basic premise for the development of a nuclear waste management facility is that it demonstrably possess the attributes of waste containment and environmental isolation. Waste containment is primarily an engineered matter whereby spent nuclear fuel is placed in a highly corrosion resistant metal container and surrounded by leach and corrosion resistant glass. The container is then sealed. These containers would then be placed at depth (500 - 1,000m) in a vault excavated within intact rock of the Canadian Shield and surrounded by a buffer of relatively impervious clay. Once a vault within the repository was filled with containers and clay buffer it would be backfilled with low permeability material and its access would be sealed with concrete or other suitable material. When all of the vaults had been filled and sealed the access shaft would also be sealed. The multiple barriers provided by corrosion resistant glass, metal container, clay buffer, backfill and concrete vault and shaft seals would preclude or severely retard leaching of the waste and return of the leachate to the environment by circulating groundwater. Further environmental isolation would be gained by locating the waste management site at a location remote from population centres. This of course raises the question of what level of concentration of population is acceptable in proximity to a waste repository? The usual public response to such a question is "zero".

The attributes of containment and environmental isolation are not necessarily mutually exclusive. The geological subsurface can, given suitable properties and conditions, provide both containment and environmental isolation. Thus sites may well be found beneath population centres that could be technically suitable for waste management purposes but which would likely never be politically or publicly acceptable.

5.) The Nuclear Fuel Waste Act (2002) defines nuclear fuel waste as "irradiated fuel bundles removed from a commercial or research nuclear fission reactor". This definition is perhaps currently acceptable if there is no intent to reprocess spent fuel for recovery of radioactive elements including uranium for future use as fuel. Perhaps consideration needs to be given to the long term place of nuclear energy as a component of Canada's energy supply. In the event of decline in supply of fossil energy sources and increased reliance on nuclear energy access to spent nuclear fuel for reprocessing may become desirable.

6.) NWMO news (Sept.2003, p.4) refers to nuclear fuel waste as being "hazardous to humans and the environment for a very long time". This statement is true particularly with respect actinides produced by the fission process such as Iodine-129, Cesium-135 and Plutonium-239 which have radioactive half lives of thousands or millions of years. Although the content of these long-lived radioactive elements in spent fuel is relatively small they do pose a particular hazard to humans if ingested or inhaled. In my view the public should be informed of the specific time period during which it is deemed by knowledgeable waste management experts of the time period required to safeguard nuclear fuel waste. It is likely that this period will be of the order of tens to hundreds of thousands of years.

Given such an extended period of time it does not seem to me to be either prudent or practical to suggest that human oversight could be applied to any form of surface or near-surface waste management facility to ensure continuing waste containment and environmental protection.

7.) The geological waste disposal concept is one that I support based upon the research that has already been done and submitted for environmental review. No one can provide any absolute guarantee that a geological repository would not be subject to some sort of physical or chemical change over the toxic period of its contained waste. Our understanding of the type and rate of geological processes including groundwater flow, however, is such that sound and reasonable assurances of containment and environmental isolation can be provided. The geological subsurface provides the substitution of secure space for the very long periods of monitoring time that would plague any sort of surface or near-surface facility.

8.) During the conduct of the Nuclear Fuel Waste Management Program many attempts were made to inform the public of the safeguards applied to the handling of spent nuclear fuel and of the geological disposal concept being investigated. It was never clear to me that many, if any, of the public either understood or accepted the disposal concept. Part of this apparent lack of acceptance may have been due to the technical complexity of the concept. I suggest, however, that a more significant cause of the lack of public support for anything nuclear may be attributed to the utterances of various antinuclear groups who are well organized, generally well informed and vociferous in presenting their point of view. The pronuclear group comprises, for the most part, those involved in the nuclear industry and tends to be viewed by many of the public as being biased in their point of view and perhaps lacking in trust. While the pronuclear group endeavours to find a responsible solution to the long term management of nuclear fuel waste I have yet to hear from the antinuclear group any constructive suggestion as to how to deal with this issue.

One of the major issues that arises in proposals for any sort of centralized waste repository is the transportation of the wastes from reactor sites to the repository. It seems not to matter to many of the public that safe shipping containers have been designed and tested for transport by either road or rail. The public simply does not want to have radioactive material shipped by whatever means through, near or even distant from their community. The fact that other hazardous, and even less securely contained, materials are routinely transported through or near their communities seems not to be relevant.

9.) In the late 1980's and early 1990's EMR established the Siting Task Force, an independent body, charged with finding a solution to the disposal of uranium refinery wastes that had accumulate for many years at Port Hope, Ont. and surrounding area. Rather than devise a solution to be implemented at some predetermined site, as was essentially the case with the Nuclear Fuel Waste Management Program, the Task Force invited all Ontario communities to volunteer as a host community for these wastes. In the event that a volunteer community met certain technical criteria for siting of a waste disposal facility and was accepted for this purpose it would receive monetary and/or other form of compensation for its effort. This approach was designed to transform the waste

from a liability to a benefit and thereby overcome the prevalent NIMBY syndrome. In a recent editorial in the journal *Ground Water* (Vol. 41, No. 4, p. 401-403, July-Aug. 2003) authors Jay Lehr and Herbert Inhaber describe a similar approach to overcome the NIMBY problem relating to what they describe as locally unwanted land uses or "LULU's". Their approach involves a form of reverse Dutch auction whereby a siting authority issues a set of acceptable site criteria, offers a level of compensation available to some community and agrees to underwrite the cost of site evaluation. If no community volunteers the level of compensation is raised until a volunteer community comes forward.

The Siting Task Force was anything but inundated with volunteer communities and, in fact, ended up with but one - Deep River, Ont, a community already involved in the management of low level wastes from the Chalk River reactor. Even this community eventually withdrew as a candidate site as it was not satisfied with the compensation package offered by the Government of Canada through the Siting Task Force. As a result the refinery wastes remain in Port Hope and area with their ultimate fate yet to be resolved.

10.) Through my experience with the public in both Nuclear Fuel and Refinery waste programs I conclude that the public is very apprehensive about radioactive materials and not particularly receptive to information regarding them. Further, the issue of transport of radioactive materials is one that is certain to invoke strong public opposition.

Previous efforts that have been made to inform the public of waste management issues, whether they be of a nuclear, toxic, landfill or other nature, do not seem to have been particularly successful in providing solutions to waste management problems.

With respect to nuclear waste management I suggest that the deficit in public education lies not in the technical aspects of the issue but in the social orientation of the public to acceptance of responsibility for the management and disposal of wastes whose origins arise from products or services of which the public have been beneficiaries. Thus, the solution to these issues may well lie in the hands of sociologists not scientists and engineers.

11.) Regardless of the best efforts of NWMO, its Advisory Council and Board of Directors in engaging the public, by whatever means, toward finding a permanent solution to the management of nuclear fuel waste I am skeptical that you will have any greater success than previous attempts that have been made to resolve this issue.

12.) With respect to dealing with, but not necessarily resolving, nuclear fuel waste issues over the next several years I suggest that the following options are possible and may be publicly acceptable:

A. Continue to store spent fuel at reactor sites either in spent fuel bays or in concrete canisters on an interim basis with the expectation of the intent to remove the spent fuel to a reprocessing facility or central repository at a later date. This option is based on: a.) the status quo which is least disruptive to the public and b.) expectation that nuclear energy will in future assume a larger component of Ontario's, and possibly Canada's, energy supply. In such an event the public may become more accepting of nuclear power and

nuclear waste management. The reactor site option is clearly not a long term solution to the waste disposal problem but it could serve as an action taken by design to better acquaint the public with the problem and to prepare them for a more permanent solution. B. Both the governments of Ontario and Canada have set aside tracts of land for such special purposes as parks, wild life preserves, military bases, airports. Thus a specific tract of land in Ontario that would meet both geographic dimensions and site acceptance criteria, including environmental assessment, could be designated, by joint action of governments with assistance from siting experts, for nuclear waste management purposes and precluded from all other uses. Such a site would, of course, have reasonable proximity to existing transportation facilities and be located in the Canadian Shield or other suitable geological environment. Once selected the site could be developed at whatever time might be appropriate in the future.

Although I do have considerable reserve over the willingness of the public to deal rationally with the very important issue of nuclear fuel waste management I do wish your organization every success in dealing with this matter.

Yours truly,

A handwritten signature in cursive script that reads "John S. Scott". The signature is written in dark ink and is positioned above the printed name.

John S. Scott

c.c. Mr. George Anderson
Deputy Minister
Natural Resources Canada