RADIOACTIVE WASTE MANAGEMENT POLICY IN CANADA

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ABSTRACT

Canada has a nuclear fuel cycle based on a unique reactor system, the CANDU, developed by Atomic Energy of Canada Limited (AECL), which uses natural uranium in a once-through fuel cycle. Its nuclear power program is sixth in the world in terms of electricity generated. This paper provides an overview of Canada's approach to the management of the radioactive wastes arising from its nuclear activities. In general, the approach combines the requirements for appropriate and safe technology and effective regulation, with the need for public participation. Issues discussed in the paper cover wastes arising from the complete nuclear fuel cycle: high level or nuclear fuel wastes, low level radioactive wastes, and uranium mine tailings.

INTRODUCTION

This paper provides an overview of radioactive waste management in Canada, beginning with a brief discussion of public acceptance and general environmental issues. The overall approach to radioactive waste management is then discussed, followed by sections dealing specifically with high level waste and uranium tailings.

PUBLIC ACCEPTANCE AND THE ENVIRONMENTAL THRUST

The nuclear fuel cycle has been for many years, and still is, subject to intense scrutiny and curiosity by the media and the public in Canada as elsewhere in the world. It has become a truism that the future of nuclear power will depend on public acceptance. In turn, public acceptance will be based on perceptions of the relative health and environmental impact of nuclear power at all stages of the fuel cycle.

What is new in recent years is that other sources of energy and of electricity are increasingly subject to a level of public examination that was once reserved for the nuclear option. Perhaps this will allow for a more balanced public debate to take place - one that puts the issues into a comparative context.

For example, hydro projects in the Canadian north, which were once considered to be environmentally benign, are now the subject of considerable discussion, involving environmental groups, the media and the indigenous people who live in the affected areas, as well as both levels of government. Fossil fuel activities are also the focus of intense public concerns about acid gas and greenhouse emissions, as well as urban air quality in some areas. The need to make energy use consistent with "sustainable development" will continue to make environmental concerns an important part of energy policies. It remains to be seen what long term impact this will have on the role of nuclear energy.

GENERAL APPROACH TO RADIOACTIVE WASTE MANAGEMENT

In essence, the general approach to radioactive waste management in Canada is that the producer/owner is responsible and must ensure compliance with the regulatory criteria. The federal regulatory agency, the Atomic Energy Control Board (AECB), has as its mission to "ensure that the use of nuclear energy in Canada does not pose undue risk to health, safety, security and the environment". Its licensing system is the mechanism by which it delivers this objective.

While the same broad management and regulatory criteria apply in principle to all radioactive wastes, the detailed approach to each type of waste varies with physical, radiological, and geographical characteristics. Although nuclear energy is an area of federal jurisdiction, the regulatory and environmental processes take provincial concerns into consideration as well, in order to avoid duplication.

AECB licensing is required for the construction, operation and decommissioning of all nuclear facilities inclusive of those related to waste management. The AECB ensure that such facilities are licensed only if the operators can show that the estimated dose to critical members of the public will not exceed 5 millisieverts or 500 millirem per year and that the doses are as low as reasonably achievable, taking into account social-economic factors (ALARA). Following the new recommendations of the International Commission on Radiological Protection (ICRP), the AECB has issued a consultative document for comment by the industry and the public on its proposal to revise the annual dose limit to 1 millisievert or 100 millirem. Licenses are renewed at periodic intervals, provided that the required conditions continue to be met.

In addition to the regulatory requirements of the AECB, it has become the practice in Canada to carry out independent and public processes of environmental review and consultation for major new activities or major new initiatives related to existing activities. In particular, most new nuclear facilities in Canada would now be referred to the federal Minister of Environment for a formal public review by an independent Panel, with full opportunity for public hearings, and with funding for intervenors.

HIGH LEVEL RADIOACTIVE WASTES

All nuclear generating stations in Canada use CANDU reactors developed by Atomic Energy of Canada Limited (AECL). The CANDU fuel cycle is based on once through use of natural uranium. The used fuel bundles are presently stored at the reactor sites and, in one form or another, will eventually become high level waste. There are currently no plans in Canada to reprocess these used fuel bundles.

To date, the absolute volumes of used fuel in Canada remain quite small. To the end of 1991, there were some 16,000 tonnes of used fuel in storage at Canada's eighteen operating reactors. This used fuel continues to be safely and economically stored in water-filled pools or in dry concrete canisters at the nuclear reactor sites.

While there is no technical urgency to proceed towards disposal of the used nuclear fuel, the Canadian government has long recognized the public's concerns on this issue, and the need to identify a permanent disposal option. In 1977, after several years of research, a task group was formed to address options for the long-term management of high-level wastes. The resulting report by Kenneth Hare recommended that geological disposal in crystalline igneous rock of the Canadian Shield be further investigated.

A detailed and comprehensive research program was initiated by AECL in 1978 to develop a disposal concept based on a geological repository in crystalline rock.

The program is generic rather than site specific, and has been developed to fully meet safety and performance criteria established by the AECB. It is based on burial, at depths of 500 to 1000 meters, in plutonic rock of the Canadian Shield, using a multi-barrier approach with a series of engineered and natural barriers. These include the fuel bundle waste form, container, buffer and backfill, and the host rock. As part of this program, a conceptual design of a disposal facility for used nuclear fuel has been developed. The research program has also developed a methodology to model the post-closure, or operational, phase of such a facility. The assessment of the Concept also includes an assessment of the pre-closure, or operational, phase of such a facility. One of the major research facilities is an Underground Research Laboratory located in Manitoba, close to the Whiteshell Laboratories of AECL Research. Construction of this facility is now complete, and experiments are continuing.

In October 1989, the Canadian Minister of the Environment appointed an independent Panel to conduct an environmental assessment and review of the concept of deep geologic disposal of nuclear fuel wastes in Canada and other related waste management issues. A scientific Review Group of distinguished independent experts was established by the Panel to conduct a specific in-depth examination of the safety and scientific acceptability of the disposal concept.

In June 1991, after public scoping sessions in 5 provinces, the Panel issued preliminary guidelines for the preparation of the required Environmental Impact Assessment by the proponent, AECL, which is to form the basis for public hearings on the concept. The preliminary guidelines have been extensively reviewed by all interested parties, and it is expected that the final guidelines for the view will be issued by the end of March, 1992. The entire review process is expected to take about five years.

The issue of siting will not be addressed until the concept itself has been found to be safe, acceptable and technically feasible, although the Panel may make recommendations about siting methods and criteria. Disposal is not expected to occur before the second or third decade of the next century.

Funds to pay for disposal of used fuel are currently being accrued by the nuclear utilities, and represent a small fraction of the cost of electricity production.

LOW LEVEL RADIOACTIVE WASTES

In Canada low level radioactive wastes (LLRW) are defined by exclusion. That is, if a waste is radioactive, but it is not high level waste, nor uranium mill tailings, then it is classed as low-level waste. In terms of the U. S. classification, all wastes from the very lowest of the Class A waste to Greater Than Class C are included. Responsibility for ongoing low level radioactive wastes lies with producer/owner while "historic" wastes on the responsibility of the Canadian federal government.

The total volume of ongoing LLRW produced in Canada is currently in the range of 4,000 to 6,000 cubic meters per year. LLRW from nuclear reactors consists mostly of slightly contaminated garbage from operations and maintenance activities with a small volume of higher activity wastes in the form of filters and ion exchange resins from purification systems, and irradiated equipment. Other sources of LLRW are slightly contaminated garbage from radioisotope uses in research, medicine and industry; building materials from decommissioning of facilities where processing of radioactive elements was carried out in the past, and process residues with low levels of radioactivity left over from the refining and conversion of uranium.

Again, the Canadian federal policy on the management of these wastes is based on the principle that the producer/owner is responsible. Waste producers can thus determine their own long-term waste management strategy. In the case of major LLRW producers, such as Ontario Hydro and AECL, this could include the development of their own disposal facilities. AECL is currently proceedings with an application to the AECB for approval to construct and operate a demonstration unit of a modular near surface disposal system at their Chalk River Laboratories site, for wastes produced by AECL, and those received on a commercial basis from small volume producers who have no interest in developing their own facilities for long term LLRW management.

The AECL system, designated as IRUS (Intrusion Resistant Underground Structure) is designed as an underground concrete vault to contain about 2,000 cubic meters of LLRW, per module. It is designed for wastes with hazardous lifetimes of up to 500 years. Pending AECB approval, construction is scheduled to start in 1992, and the first unit should then be in operation by the end of 1993.

However, a large proportion of the existing inventory of LLRW in Canada consists of "historic wastes". These are wastes that are managed in a manner no longer considered acceptable and for which the original producer cannot be held responsible. In 1982, the government established the Low Level Radioactive Waste Management (LLRWMO, or the Office) as the federal agent responsible for the clean up of sites contaminated by these wastes, and in the spring of 1990 renewed its commitment to continue the operation of the Office.

Approximately 90 per cent of Canada's current inventory of LLRW are located in the Port Hope area of Ontario, east of Toronto, on Lake Ontario. The wastes are largely a result of the radium industry and the early days of the uranium industry and these wastes have long lived components.

Waste management practices of that era were not comparable to those required by modern standards. These wastes and contaminated soils contain uranium, radium, arsenic, and thorium as well as other heavy metal contaminants associated with the original uranium ore.

In 1980, the AECB directed Eldorado Nuclear Ltd., the Crown Corporation, to develop plans for decommissioning of the major waste management sites. However, attempts to find a permanent site for the wastes were largely based on technical, scientific and economic considerations and led to a public outcry by local residents. The degree of community opposition

rose to such a point that, in 1986, the Canadian government cancelled the siting process and initiated an independent task force with a mandate to come up with suggestions for a less-confrontational process that would lead to the resolution of this siting problem.

The report of the independent Siting Process Task Force, entitled, "Opting for Co-operation", recommended an approach based on voluntary participation of communities that are interested in developing a waste facility. This process includes joint planning, information sharing and decision-making...that is, real consultations not just "public relations". It also includes full community compensation for both participating in the process and for eventually hosting the facility. The approach is very different from the traditional practice of Decide-Announce-Defend (DAD). The recommended process was consistent with the public's demonstrated desire to be involved in decision-making and met all of the criteria for consultation embraced within the federal government's environmental assessment and review process. The government accepted the challenge and appointed a second task force, the Siting Task Force on Low-Level Radioactive Waste Management, to implement this new community-based process.

This initiative was launched in late 1988 and has been successful to date. After two years of consultation with fourteen voluntary participant communities, six of them have expressed a continuing interest. Three "source" communities and three "host" communities have opted to continue through the remaining phases. In late August 1991, the government announced a four year, $22 million continuation of the Siting Task Force to undertake the technical review and environmental assessment of management options and, ideally, to conclude negotiations that will hopefully lead to one of them becoming a host community.

Ultimately, any proposed facility will have to be approved by the AECB. It is expected that the regulatory agency would consider a range of rational and safe technological options for the long-term management of these wastes.

In Canada, as well as in other countries, this siting process is being watched with interest by many organizations which are attempting to site controversial facilities. If successful, this approach will have applications in other areas of the nuclear fuel cycle as well as in the siting of other hazardous or controversial facilities.

In parallel with, and complementary to, the Siting Task Force process, the Office has completed cleanup work at a number of historic waste sites on an interim storage basis. Experience has shown that a comprehensive public consultation process can be successful in establishing interim storage facilities at the sites where the contaminated soils are located. This is in contrast to the unsuccessful outcomes of earlier efforts to establish interim storage sites involving relocation of the wastes.

URANIUM TAILINGS

In Canada, over 185 megatons of uranium tailings have been generated since the mid-1950's. These comprise about two per cent of all mine tailings in the country.

Uranium tailings sites in Canada, which are about to be decommissioned, are likely to be submitted to the Minister of the Environment for a federal environmental assessment and review in addition to the decommissioning process and review by the AECB who will issue the decommissioning license. As for the uranium tailings from proposed new developments, such as those planned in northern Saskatchewan, the federal environmental and assessment public review of the overall mining and milling development would also include the review of the decommissioning plans for the site.

With regards to financial responsibility, the AECB has recently established a policy for the decommissioning of uranium mining operations which includes a requirement for the management of tailings. The policy relates to new mining ventures and requires that operators submit a decommissioning plan for the facility and the waste management areas before an operating license can be granted. The operator must provide financial assurances that decommissioning will take place in a responsible and orderly manner in the short as well as long term. Indeed, in some of the more recent mines, many of the tailings impoundments were built at an early stage of development and their cost is an integral part of the overall cost of operations.

In most cases, owners of Canadian mines that were shut down before the current policy on tailings responsibility was in place are in principle required to take financial responsibility for decommissioning the sites to current standards. As standards become more stringent, remedial work required for tailings can become expensive; where a responsible owner cannot provide the necessary funds or cannot be identified, responsibility for decommissioning would rest with the Canadian federal and provincial governments.

CONCLUSIONS

The Canadian Government has recently reaffirmed its support for both the uranium and nuclear power industries. In parallel with this support for the industry, the government has recognized the importance of radioactive waste management activities and has taken appropriate action on both technical and public participation fronts.

The Canadian concept for disposal of nuclear fuel waste deep within the crystalline rock of the Canadian Shield is presently undergoing a federal environmental assessment and review process, which will involve a comprehensive scientific and technical review in addition to full public hearings. There will be no site selection process until the concept has been accepted as safe and technically feasible.

With regard to LLRW in Canada, and specifically "historic waste", the issues of clean up of contaminated sites and siting of a disposal facility are important priorities for the federal government. In 1988, the Siting Task Force was established to implement a cooperative, voluntary process to find a site for these wastes, and in August 1991, the government renewed its commitment to this process.

In the area of uranium tailings, past and present research work provides a sound basis for evaluating the potential environmental impact, in both the short and the long term. The nuclear regulatory agency has established guidelines for decommissioning tailings sites, and discussions are ongoing to ensure that, at the appropriate time, funds will be available to carry out these decommissioning plans which will be subject to thorough environmental review.

In summary, the Canadian government is committed to policies for the management of radioactive wastes from the nuclear fuel cycle that combine the need for public participation, effective regulation, and the use of sale and environmentally sound technologies.

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