UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 10 1993

MEMORANDUM FOR: Richard L. Bangart, Director
Division of Low-Level Waste Management
and Decommissioning

FROM: E. William Brach, Deputy Director
Division of Low-Level Waste Management
and Decommissioning

Robert Nelson, Project Manager
Licensing and Coordination Section
Low-Level Waste Management Branch
Division of Low-Level Waste Management
and Decommissioning

Donna K. Smith, Physical Scientist
Licensing and Coordination Section
Low-Level Waste Management Branch
Division of Low-Level Waste Management
and Decommissioning

SUBJECT: TRIP REPORT TO VISIT LOW-LEVEL WASTE STORAGE FACILITIES IN CANADA

From January 11 through January 14, 1993 the undersigned traveled to Toronto and Ottawa to meet with officials from the Atomic Energy Control Board (AECB), visit the low-level waste (LLW) storage facilities at Bruce Nuclear Power Development (BNPD), meet officials from the Atomic Energy of Canada Limited (AECL), and tour the LLW storage facilities at the AECL Chalk River Laboratories (CRL). The purpose of the trip was to become familiar with Canadian approaches to and experiences in storage of LLW so that their practices and lessons learned can be considered in our planning for increased storage of LLW in the US.

The following report summarizes the trip (a copy of the itinerary is enclosed), identifies the individuals with whom we met, and provides major observations and a description of discussion topics.

AECB - Toronto

In the initial meeting with officials from the AECB on the afternoon of January 11, plans to visit BNPD and AECL Chalk River Laboratories were finalized, the NRC staff was briefed on the respective sites, and Canada's regulatory program for low-level waste storage and disposal was discussed. George Jack (Director of Wastes and Impacts Division) initiated the meeting with a brief description of the AECB. Paul J. Conlon (Section Leader in the Wastes and Impacts Division) presented an overview of storage facilities and technical information for both BNPD and CRL. Also present from the Wastes and Impacts Division was Andre Regimbald (Project Officer for AECB).

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AECB - Headquarters Ottawa

The final meeting, January 14, with the same AECB officials as mentioned above, following the visit to BNPD and CRL, focused on observations at BNPD and CRL, public involvement in AECB regulatory activities involving storage and disposal, and an overview of Canada's experiences with LLW storage. The topics discussed during both the initial and final meetings with AECB included the following:

- AECB is the regulatory agency whose responsibilities are similar to those of NRC. The AECB Board consists of five members. The President of the Board is the only full time Board member.

- The Wastes and Impacts Division is under the Directorate of Fuel Cycle and Materials Regulation and is responsible for the regulation of radioactive waste management and decommissioning of nuclear facilities.

- The AECB staff implements the policies of the Board and makes recommendations to the Board concerning the issuing of licenses and other regulatory matters. The AECB has increased their staff from 334 in March 1992 to approximately 400 by December 1992.

- Even though Canadians view disposal as preferable over storage, there has yet to be a disposal site licensed. All LLW has been managed by placement in interim storage facilities for over 40 years. AECB received its first license application for a LLW disposal facility (Intrusion Resistant Underground Structure - IRUS) from the AECL in May of 1992. The application is currently in the review process. AECB had their first application review meeting with AECL on January 12, 1993. This meeting was not open to the public. AECL anticipates operation of IRUS in 1996. IRUS is further discussed below.

- AECB regulations are general in nature, broadly based on performance criteria. To obtain a license for LLW storage, it is the responsibility of the licensee/applicant to present to the AECB what actions are planned, explain how its storage facility meets the performance criteria, and how ongoing safety will be ensured.

- Long-term management of LLW (whether it be storage or disposal) is the responsibility of the waste generator. Nuclear utilities in Canada currently store their own generated LLW. Each nuclear utility operates one storage facility that receives waste produced from each of its nuclear power reactor sites. The BNPD site is the central storage repository for all LLW generated by the three Ontario Hydro nuclear power sites. The two other nuclear utilities store their waste at their respective nuclear power plant sites. AECL stores the remaining LLW generated in Canada from hospitals, universities, etc. at CRL.

- The AECB issued a Regulatory Policy Statement R-85 in 1989, governing the exemption of certain radioactive materials from further licensing

upon proposed transfer for disposal. Specifically, the policy statement states:

> "...the criteria by which the AECB will determine the acceptability of applications for the exemption of certain radioactive materials from further licensing...The AECB will use a de minimis dose of radiation to individuals of 0.05 millisievert [5 mrem] in a year for deciding such exemption on a case-by-case basis, provided that the radiological impact will be localized and the potential for exposure of large populations is small."

- There are two private waste processors located in Toronto and Montreal, licensed by AECB, who compact waste from other than power reactor generators prior to shipment to AECL.

- AECB's review of a license application is an iterative process. The following steps outline the interaction between the AECB and an applicant:

  - The applicant must first submit a letter of intent which may be accompanied by the application.
  - The AECB releases a public information notice.
  - The applicant submits a request to the AECB asking permission to begin construction.
  - AECB establishes the review staff and solicits assistance, as required, from other government agencies to help in the review.
  - The project officer is the liaison between the AECB (including the sister agencies involved in the review) and the potential licensee.
  - The applicant must develop a public information program and submit a description of their proposed program to the AECB. The program must contain the following information:
    - how the applicant defines the "affected public"
    - how the applicant intends to reach the "affected public"
    - content of the message to the public

    The AECB will monitor any public hearing or public communication to determine accuracy and clarity of content and to observe questions, concerns, and reactions of the public.
  - Supporting documentation and technical information is requested from the applicant as needed. This process is similar to the NRC's review process.
  - When the AECB staff review is complete, the staff recommends that the AECB Board consider final AECB action (e.g., license issuance).
  - The Board allows two weeks for public comment prior to the first of two Board meetings. The public must register with the Board if they want to raise any issues at the first meeting.

- Following the first Board meeting, the staff responds to Board and public questions. At the second Board meeting, the Board deliberates in private then provides their final decision.

Ontario Hydro - BNPD

On the morning of January 12, NRC staff departed Toronto for BNPD. At BNPD, we were briefed by Brian Vaughan (Technical Superintendent of Waste Management for BNPD) on the waste management program at the BNPD site. Following the briefing we toured the Radioactive Waste Operations Site 2 (RWOS 2) which consists of the Radioactive Waste Processing Facility and Radioactive Waste Storage Facilities.

Ontario Hydro is the largest Canadian nuclear utility and operates nuclear generating stations at Darlington, Pickering and BNPD. Ontario Hydro has two waste management sites located at BNPD to store low and intermediate level waste. The first of the two sites, Radioactive Waste Operation Site 1 (RWOS 1) was in use until 1974 and is now closed and monitored regularly. The other site, RWOS 2, operated by approximately a ten person staff, is larger and meets all of Ontario Hydro's current waste storage needs.

Ontario Hydro classifies its low and intermediate level waste according to its radioactivity, determined by contact dose rates, and physical composition. Type 1 LLW consists of waste with a contact dose of less than 0.2 rem/hr. Type 1 LLW makes up 97 percent of total waste stored. Type 1 LLW is further classified as being either incinerable, compactable, or non-processible. Type 2 LLW consists of waste with a contact dose of greater than 0.2 rem/hr and less than 15 rem/hr (3% of total). Type 3 intermediate level waste is waste with a contact dose of greater than 15 rem/hr (<1% of total).

For the past two decades, a radioactive waste volume reduction facility, consisting of an incinerator, a waste drum compactor, and a low-force baler, has been used for achieving volume reduction. Seventy percent of waste received at RWOS 2 is incinerable with volume reduction capability of 66:1, 10% is compactable with 4:1 volume reduction capability, and 20% is non-processible. Newer incineration and super-compaction technologies are being investigated. Waste segregation and sorting are done at the generating reactor site. The RWOS 2 operations process the waste as received. There is no further sorting or decontamination activities at the RWOS 2 to facilitate volume reduction of LLW.

Types of Storage Facilities at BNPD

Low-Level Storage Buildings (LLSB) are above ground warehouse type structures used to store volume reduced, low specific activity waste (waste which has a contact dose rate of less than 1 rem/hr). LLSBs are made from prefabricated, prestressed concrete consisting of 38 cm thick walls with overlapping joints, 16 cm thick walls with support columns, and poured concrete floors. Spills

are collected in a sump through the floor drain and leakage is detected by another sump that collects water from below the floor. The building dimensions are 50 m long by 30 m wide by 8 m high with storage capacity of 8000 cubic meters. LLSBs are protected by a fire detection and a carbon dioxide deluge fire suppression system. Per unit volume, LLSBs are more economical to construct (3 million dollars) than below ground structures, offer more efficient use of the land, and allow stored waste to be "cascaded". Cascading is the process of retrieving waste from the concrete trenches or other engineered below grade facilities that has decayed to low enough levels to be stored in the LLSB. This provides reusable space in the other structures for higher activity LLW, reducing the need to construct additional costly below grade facilities. BNPD currently has six LLSBs with two in active use and one under construction.

Quadricells are modular above ground storage structures primarily designed to contain bulk spent ion exchange resins. There are 15 quadricell modules in the quadricell facility. A quadricell module consists of a cubic outer structure divided into four cells and a cylindrical concrete vessel placed within each cell. The interspace between the cylindrical vessel and the outer structure contains a sump which is monitored. Quadricell modules measure 5.5 m long, 6 m wide, and 5.5 m high. Each quadricell module has a storage capacity of 24 cubic meters. The quadricell design has been replaced by the less expensive and more space efficient in-ground containers.

Concrete Trenches are shallow in-ground structures used to store Type 2 waste. They measure 3 m wide, 40 m long, and 4 m deep with 38 cm thick walls. The bottom slopes to a sump and standpipe to permit water detection, monitoring, and removal. Once full, trenches are covered with 30 cm thick precast concrete lids with neoprene gaskets. After a period of heavy rain one of the trench sections rose 15 cm. Underdrainage was installed to correct this problem in the other trenches. Trenches have been replaced at BNPD with the development of in-ground containers discussed below.

Concrete Tile Holes are in-ground structures for Type 3 waste. Most contain a retrievable steel liner and are capped with a concrete lid when full. Tile holes have an inside diameter of 60 cm and a depth of 3.5 m. The space between the tile hole and its liner is monitored for water. Subsurface water around the tile holes drains to a sample station. This design has also been replaced by the more economical in-ground container.

In-Ground Containers (IC) are now being built for higher activity LLW. ICs are made from carbon steel liners concreted into augured holes. A retrievable inner carbon steel liner is used unless the waste has its own steel container. ICs are less expensive and faster to construct than the quadricells, concrete trenches, and tile holes. A sample line, in the space between the outer and inner liner, is routinely monitored for water or other contaminants. Coal tar epoxy protects the containers from corrosion. ICs have a storage capacity of 2 to 12 cubic meters depending on the size of the inner liner.

The AECB requires that the BNPD maintain a certain amount of empty waste storage space to serve as reserve storage. This reserve storage is set aside in the event of an accident at one of the Ontario Hydro nuclear sites.

Ontario Hydro currently has no definite plans for disposal of their LLW. Based on discussions during our visit, it appears Ontario Hydro is monitoring the progress made by AECL in their development of the IRUS disposal facility.

AECL - Chalk River

On the morning of January 13 the NRC staff departed Ottawa for AECL Chalk River Laboratories. A brief summary of the discussions with AECL follows:

Leo Buckley (Manager - Waste Processing Technology) initiated the meeting with background information concerning the AECL. AECL is a Federally funded government corporation that promotes the uses of nuclear energy. Three divisions compose the AECL: AECL Research (CRL and the Whiteshell Laboratories in Manitoba) performs research, development and demonstrations; AECL CANDU designs, constructs, and provides engineering services; AECL Inc., with an office in Washington, D.C., is the commercial division to promote the technical services of AECL Research and AECL CANDU. AECL Research at CRL consists of a 2400 person staff. AECB began regulating AECL in 1980. Mr. Buckley also hosted the visit at the AECL facilities.

John Torok (Research Engineer) presented information concerning the site characteristics of AECL-CRL property. The CRL site covers 30 square kilometers of a Graben or Rift valley located along the Ottawa River in the Greenville province of the Canadian Shield. The area receives 830 mm of annual rainfall. The bedrock consists of fluvial and aeolian sand which allows good drainage. Limited areas exist for disposal facilities because of the limited areas with sufficient depth to the water table. The depth to the water table ranges from 5-10 meters.

R.E. (Bob) Donders (Project Scientist) outlined the sources and types of radioactive waste managed at CRL which consists of the following: isotope production, isotope users, reactor operations, nuclear research and development, decommissioning, fuel fabricators, irradiated fuel, contaminated soil.

Norm W. Edwards (Customer Service Representative) presented an overview of past and present waste management operations and hosted the tour of the LLW management facilities as listed below.

- Waste Management Area "A" (WMA "A"), in operation between 1946 and 1952, was CRL's first waste burial site. LLW was buried directly into the sand. Also waste from a 1952 reactor accident is buried at this site.

- WMA "B" began service in 1953, with LLW buried in sand trenches. In 1955 engineered facilities began with asphalt lined trenches which evolved into the cylindrical bunkers and tiles holes that are used today and as described below.

- WMA "C", consisting of a series of sand trenches, became operational in 1963. By 1982, 30 sand trenches were used. The LLW placed in WMA "C" is limited to radioactive waste with hazardous lifetimes of up to 150 years (ten half-lives less than 150 years). As a result of contamination/migration, one quarter of this area was covered with a plastic membrane and AECL reported that the diversion of the surface water runoff has significantly reduced the migration of the waste, mainly tritium. No off-site migration has been detected.

- There were four other waste management areas at CRL not included in our tour. These areas contain contaminated soil and equipment, concrete canisters for dry storage of spent fuel, and other radioactive waste. Contaminated soil is being stored pending a decision on final disposal.

Types of Storage Facilities at CRL

Cylindrical Concrete Bunkers are used to store waste that can be handled safely without protective shielding. Located near-surface, at least one meter above the highest level of the water table, the bunkers measure 6.1 meters in diameter, 4 meters deep with a capacity of 99 cubic meters. Each bunker has a sump from which water that has collected is removed and sampled.

Concrete Tile Holes are similar to those used by Ontario Hydro. They are used to store higher level activity waste such as used nuclear fuel bundles (HLW). Tile holes enable waste to be emplaced directly from a transportation shielding cask while maintaining shielding for workers. The diameters of the tile holes range from 30 cm to 1 meter and have a depth of about 5 meters. Some have a steel liner as an added containment barrier and each hole is closed with a removable shielding plug.

Disposal at CRL - IRUS

Bruce A. Lange (Senior Project Manager) presented information on future disposal plans at AECL-CRL. AECL submitted the first LLW disposal license application to the AECB in the Spring of 1992 requesting approval to construct and operate a demonstration unit of a near-surface disposal system at CRL. The AECL disposal concept is called an Intrusion-Resistant Underground Structure (IRUS). Each IRUS unit will be an underground concrete vault measuring 30 m long, 20 m wide, and 10 m deep designed to safely contain 1980 cubic meters of LLW with hazardous lifetimes of up to 500 years (ten half-lives less than 500 years. IRUS is designed to be situated with the bottom of

the facility one meter above the groundwater table and the concrete roof below the frost level. Drainage barriers will be used to direct rain water away from the repository. Water that does seep into IRUS will exit through a porous bottom sandy layer, designed to remove radionuclides that may be picked up by the water. Doses to intruders and the public are limited to 5 mrem/year. Review of the IRUS application is expected to be completed by the AECB within the next two years, with operation scheduled by 1996.

Conclusion

Early practices of LLW storage in Canada gave little consideration to waste form, packaging, or waste segregation. The early CRL facilities were not engineered with ease of retrievability in mind. Various activity level materials were interspersed in sand trenches, while some concrete trenches were back-filled with sand and gravel, and sealed with a poured concrete cover to create a concrete monolith. Earlier facilities were also not engineered to preclude ground and surface water infiltration. Covers and side walls were permeable and some engineered facilities experienced "bath-tubbing" and required installation of sumps.

Although segregation of LLW by activity level is currently practiced at both BNPD and CRL, there is not much emphasis placed on waste form development or package integrity. The only requirement for most waste to be received into storage is that the waste be dry and limited to no more than 1% free liquid. The packages to be stored in cylindrical concrete bunkers or tile holes at the CRL are expected to maintain their integrity for a 10 or 30 year period. There is no package requirement for LLW placed in sand trench storage or in the IRUS disposal facility.

Early LLW storage facilities and some current storage facilities of the AECL resemble shallow land burial. Based on discussions with AECL and AECB, analyses of the waste buried in these trenches may show that the wastes may remain in situ instead of being excavated and reprocessed for disposal.

Retrievability of LLW is currently recognized as an important requirement for storage facility design. Current storage designs and practices address waste activity level for segregation and the permeability of the facility cover and walls to ground and surface water. Retrievability in these more recent storage facilities is accomplished with minimal effort (e.g., lift cover and remove).

It was observed by the NRC staff that effective competent, storage facilities can be licensed and constructed without the need for detailed prescriptive regulations. The AECB's ability to perform the review of a storage license application appears to be in part the result of a limited number of organizations involved in waste management (AECL and three nuclear utilities).

The trip by the NRC staff to visit LLW storage facilities at BNPD and CRL and to interact with AECB officials was valuable in that observations and topics discussed addressed concerns and issues directly related to questions and issues concerning LLW storage practices, policies, and regulations here in the US. At the conclusion of the meeting, George Jack expressed an interest in maintaining dialogue with NRC on LLW, decommissioning, uranium mill tailings,

and related matters. He noted that in the past, he and his staff have had more interactions with Europeans on these matters but that the US and Canada have much in common to share.

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Enclosures: Itinerary

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MEMORANDUM NOTE DE SERVICE

To / A:
W. Upshaw, U.S. NRC, Washington
P. Stevens-Guille, Ontario Hydro (H11-A27)
B. Vaughan, Ontario Hydro (BNPD)
H. Morrison, Ontario Hydro (BNPD)
D. Tregunno, AECL-Ottawa; D. Champ, AECL-CRL

From / De:
T. Diamantstein
995-7082

Security Classification - Classification de sécurité:

Our File - Notre référence: 11-2-5

Your File - Votre référence:

Date: January 5, 1993

Subject / Objet: U.S. NRC Technical Visit, Jan. 11 - 14, 1993

As discussed with you earlier, I am sending you the complete itinerary fot the visit of the U.S. NRC team.

US NRC Team:
- E. William Brach, Deputy Director, Division of Low-Level Waste Management and Decommissioning; Office of Nuclear Material Safety and Safeguards (NMSS)
- Paul Lohaus, Chief, Low-Level Waste Management Branch, NM
- Bob Nelson, Senior Project Officer, Low-Level Waste Management Branch, NMSS
- Donna Smith, Low-Level Waste Management Branch, NMSS

AECB Team:
- George Jack, Director, Wastes and Impacts Division
- Paul Conlon, Head Non-mining and Waste Facilities Section
- Bill Whitehead, Project Officer
- André Régimbald, Project Officer

Monday, Jan. 11

13:30 US NRC team arrives in Toronto
15:00 AECB/US NRC technical discussions held at
Bristol Place Hotel, 950 Dixon Road, Toronto
Nightsbridge Conference Room (2nd floor of hotel)
Tel. (416) 675-9444 or 1-800-268-4927

Res. nos. 5470059, 0852618, 3801378, 2569971, 5460579 (Bill W.)

Tuesday, Jan. 12

08:30 Drive to Bruce Nuclear Power Development
US NRC team accompanied by Bill Whitehead
Car rented by AECB
Airport Thrifty Car Rental Tel (416) 673-8811

11:30 Arrive at BNPD

Canada

7540-21-798-8288

Enclosure

DC 177 (Rev 10)

12:30 Visit BNPD waste management site

Ontario Hydro contact: Hugh Morrison
Tel (519) 361-2673 ext. 3389

16:30 Return to Toronto (airport)

Fly to Ottawa on Canadian flight no. 930 at 21:00
Res. no. 5SD 4XB (for four)
Canadian Airlines (416) 798-2211 or 798-3115

Reservations made at Roxborough Hotel for US NRC team
123 Metcalfe Street, Ottawa [$73/night]
Tel (613) 237-5171 Res. nos. 37, 38, 39

Wednesday, Jan. 13

8:30 - US NRC team met in hotel lobby by André Régimbald
Drive to Chalk River

Thrifty Car Rental Tel (613) 238-8000

Visit AECL-CRL waste management facility

AECL-CRL contact: Doug Champ
Tel. (613) 584-3311

15:00 - Depart Chalk River

Thursday, Jan. 14

8:30 - Technical review session at AECB
270 Albert Street, Ottawa
6th floor Conference Room

AECB contact: George Jack
Tel. (613) 995-4055

PM - US NRC team departs for Washington

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