[Form 2 (to be reported to Committee on Countermeasures for Contaminated Water Treatment and to be disclosed to public)

Technology Information	
Area	1 – Accumulation of Contaminated Water
Title	1-4 – Facilitating removal of the bolted type of tanks, decontamination of tanks and long-term storage of radioactive spent filters
Submitted by	Candu Energy Inc., SNC-Lavalin, Atomic Energy of Canada Ltd., Canadian Nuclear Partners

1. Overview of Technologies (features, specification, functions, owners, etc.)

FACILITATING REMOVAL OR REPAIR OF THE BOLTED TYPE OF TANKS AND DECONTAMINATION OF TANKS

Description

In light of leakage from flanged joint type tanks, found on August 19 this year, flange tanks are to be replaced with welded types. It is necessary to accelerate the installation of welded tanks. The tanks contain RO waste liquid RO freshwater, ALPS processed water and concerns 310 units.

In view of finding a small leak in limited number of flanged tanks, thought should be given to repairing some or all of the suspected tanks rather than to attempt a whole sale replacement of all 310 units. This may prove to be the fastest means of securing capacity and offer a solution that is as secure as replacement. In addition, in-place repair would reduce the quantity of radioactive waste generated.

a) Salvaging existing flanged tanks by repair

The suspected tanks shall be isolated and drained. To commence repair, initially only limited number of tanks need to be drained, hence say temporary storage for 10 tanks need to be provided. Once the tanks are repaired the fluids from the other tanks can be transferred to those repaired tanks.

Temporary storage for the capacity of (10) flanged tanks could be made nearby by as a fully lined and covered reservoir permitting gravity flow, complete with slab mounted filtration and recirculation skid units. This reservoir will also receive the water used for decontamination of the internal of the suspected flanged tanks.

After the suspected flanged tank(s) is drained and decontaminated, the mechanical joints should be seal welded from inside, and the bottom corner joints reinforced. If a large gap exists at the joint backup rings made from mild steel should be used and seal welded in place.

The full lengths of each seal weld (min. 1/8”) shall be examined either by LP or MP examined. No hydro test is required because the structural integrity of these tanks was proven, however if judged necessary a sporadic vacuum test could be made.

b) Decontamination of tanks

We are proposing to decontaminate and remove all the related contaminants from the tank internal surfaces near the joints only. Remote radiological survey and remote camera will be required to characterize the contaminants and then identify the appropriate decontamination technique (e.g., mechanical cleaning, chemical and electrochemical decontamination).

SOLID RADIOACTIVE WASTE MANAGEMENT FACILITY FOR SPENT FILTERS

Description

If required, spent filters characterized as intermediate level waste, will be dewatered and dried before a shielded flask removes the filter from its housing. It will then be transported to an intermediate-level solid radioactive waste storage facility. This is a single concrete structure designed for storage of the intermediate level spent filter cartridges. It contains several holes with dedicated covers having a nominal slope to minimize rain water infiltration. Each hole is subsequently sealed after it is completely filled. Each hole also has a drain to remove any rainwater infiltration, and the drain is also sealed to prevent any ingress of humidity, subsequent to filling of the container.

The low level spent filters will be placed into containers and then stored in a low-level solid radioactive waste storage facility. It consists of prefabricated concrete walls and roof assembled on a reinforced concrete floor. The concrete walls and roof of the structures are thicker than is required for structural purposes alone, thus providing the shielding. The concrete panels are joined in an overlapping configuration to prevent “radiation shine” between panels.

The design bases for the solid radioactive waste storage facilities are identified below (but not limited to):

1) The type and thickness of walls shall provide adequate radiation shielding for operations staff and the public.
2) The design of the facility shall be such as to facilitate the inspection of the structures, systems and components of the facility, and of the waste and waste packages stored in the facility.
3) The facility is to be sited on or in foundation material with good drainage characteristics. The lowest points in the concrete must be above the water table. A floor drainage system shall be connected to an outside sump to collect any radioactive and non-radioactive liquids from inside the building.
4) Proper ventilation shall be provided, including HEPA filter, monitoring and exhausts methods.
5) The storage building shall be seismically qualified and must satisfy the meteorological design parameters imposed by the applicable building code for protection against tornado.
6) A fire protection system shall be of appropriate capacity and capability where there exists a credible risk of fire.
7) Controlled access and movements between the radiation zones shall be provided with possible automatic restriction to authorized personnel only and a below atmospheric pressure in the storage of contaminated material to be maintained, where applicable.
8) Waste handling equipment shall be designed for safe operation, avoiding damage to the waste package, safe handling of damaged waste packages, minimizing contamination of the handling equipment and avoiding the spread of contamination.

9) Sufficient capacity to be provided for short-term storage of all spent filter cartridges.
10) Provisions to be provided for on-site transportation of all types of spent filter cartridges.
11) Electrical power supply to be provided for lighting, over-head crane (if used), and the motorized winch for the shielding flasks.
12) Equipment for checking facilities for radioactive contamination on personnel, transport vehicles and storage structures shall be provided.
13) Containers will be designed and fabricated to contain the waste under all conditions of operation during their lifetime. The strength and integrity of the container is appropriate for the type, properties and the radioactivity level of the waste.
14) Chemical stability against corrosion caused by waste or external conditions; and resistance to operational loads or accidents.

*2. **Notes (Please provide following information if possible)***

- *Technology readiness level (including cases of application, not limited to nuclear industry, time line for application)*
- *Challenges*
- *Others (referential information on patent if any)*

FACILITATING REMOVAL OR REPAIR OF THE BOLTED TYPE OF TANKS AND DECONTAMINATION OF TANKS

Benefits

Repair of existing tanks in stages will significantly improve the available capacity rather the removing all 310 tanks and replacing with new, not to consider the decontamination effort, since the liquid from tanks to be repaired will not require filtration for the transfer purpose.

Moreover the site will gain an underground reservoir which could be utilized (after the repairs are completed) for collection of rain water runoff, permitting monitoring, dilution and controlled run off.

Issues/Challenges

Is to ensure that a suitable monitoring is provided and the reservoir lining and covers are of similar quality as those used for number of years in CANDU stations.

Project Examples of Application and Readiness

Once a decision is made and the necessary approvals obtained the repair of the reservoir could commence.

Candu Energy has an assortment of remotely controlled robotic technologies that can operate in high radiation fields. The company has used these technologies to successfully conduct remote activities like welding or non-destructive examination for operating reactors. Candu Energy has some robots in its fleet that are ready for use with some customization for the radiological survey and decontamination techniques proposed above.

Case applications of remote operation technologies by Candu Energy include:

i) Underwater cutting of Pressure Tubes (PT) and End Fittings (EF) in the spent fuel bay. Work included transfer of equipment, performing the inspection and marking of the cut locations, performing underwater cutting. The technology featured an onboard filtering system that would catch all the cutting chips in a filtering unit and recycle the water back into the spent fuel bay;

ii) Remote inspection of spent fuel transfer structures with accessibility constraints and high radiation. Inspections to locate discontinuities in concrete were performed remotely and underwater by using camera and video recording equipment;

iii) Complex remote welding tool to repair perforation in an aluminum reactor vessel. The challenges of delivering the weld from a height of 30 ft and through a 4.75 inch diameter hole were met successfully;

iv) Development of Reactor Vault Inspection Tool for inspections of the inside of the reactor vessel and Debris Removal Tool for pickup of large items such as swab cloths as well as small items such as wires. Both tools have articulating and telescoping arms that can cover 360° rotation and 100° arm flexion and are controlled by remote operations.

Intellectual Property/Patent Aspects

SNC Lavalin, CANDU Energy Inc. and AECL maintain IP and some patent rights on remote tooling they have developed.

SOLID RADIOACTIVE WASTE MANAGEMENT FACILITY FOR SPENT FILTERS

Benefits

The solid radioactive waste storage facilities can be designed to accommodate various type and size of spent filters and radioactivity levels. The design of solid radioactive waste storage facilities is based on international standards for the management of radioactive solid wastes.

Issues/Challenges

Spent filters have to be characterized (size, type, activity level, etc.) to identify the appropriate storage facility.

Safety and shielding assessments have to be performed prior to their implementation. Candu Energy has considerable experience (>50 years) in performing safety and shielding assessments for nuclear power plants and nuclear facilities (e.g. low-level, intermediate-level and high-level waste storage facilities).

Project Examples of Application and Readiness

New intermediate-level waste storage facilities were developed for storage of refurbishment and operational wastes (e.g., retube wastes, spent filters, etc.) at CANDU Nuclear Power Plants in Canada and South Korea. Low-level waste storage facilities were built at many CANDU sites in Canada (e.g., Gentilly 2, Pt. Lepreau). At the Chalk River Laboratories (Ontario, Canada), Shielded Modular Above Ground storage (SMAGS) buildings are providing storage for low-level wastes produced at this site. Ontario Power Generation is operating the largest solid-waste storage facility for the management of low and intermediate level waste in Canada (Western Waste Management Facility at Bruce site, Ontario, Canada).

Intellectual Property/Patent Aspects

CANDU Energy Inc. and AECL maintain IP and some patent rights storage technologies and tooling they have developed

Storage Vaults for Low-Level Radioactive Waste