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

Technology Information	
Area	6 - Understanding the Groundwater Flow
Title	6-3 – Dig observation holes
Submitted by	Candu Energy Inc., SNC-Lavalin, Atomic Energy of Canada Ltd., Canadian Nuclear Partners

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

For digging observation holes with minimum amount of work man-hours or unmanned boring, we are proposing remote drilling.

2. Notes (Please provide following information if possible)

- *Technology readiness level (including cases of application, not limited to nuclear industry, time line for application)*

The Candu consortium has an assortment of remotely controlled robotic technologies that can operate in high radiation fields. Our team have customized these technologies to successfully conduct remote activities (e.g. welding, NDE) on research and operating reactors in extreme radiation fields. The approach is to use engineering and robotic solutions to tackle tough project in high radiation fields. We have some robots in our fleet that are ready for use; however, those would have to be customized for these particular applications.
The Candu consortium has extensive experience related to designing and applying tooling for remote operation in radioactive environment. Few examples are provided below.

- A project that required cutting of Pressure Tube (PT) and End Fitting (EF) sections located in the spent fuel bay was recently completed. The tooling was capable to transfer the equipment from the dry storage to the spent fuel bay. Work included the transfer of the equipment from the flask to the platform, performing the inspection and marking of the cut locations, performing underwater cutting of the PT and EF sections. The system was equipped with an onboard filtering system that would catch all the cutting chips in a filtering unit and recycle the water back into the fuel bay. The cutting system was composed of a hydraulic motor and a cutting wheel driven by hydraulic pump located outside the fuel bay. The project was a success and all the necessary inspection and the cuts were performed within the schedule.
- We developed tooling for underwater camera inspections of spent fuel transfer structures in areas with accessibility constraints (due to geometry and radiation) at a nuclear research facility. Inspections to locate discontinuities in concrete were performed remotely, underwater using camera and recording equipment.
- Corrosion of the aluminum reactor vessel had thinned the wall and caused perforation in several areas and the vessel wall was corroded in a few places from the outside. The nearest human access was 30 ft above the repair site with access through a 4.75 inch diameter hole, also repair of irradiated aluminum made this repair a complex challenge. It was recognized

early in the program that a variety of remote tools would be required to execute such a complex repair. One of the main custom tools produced was a complex remote welding tool to apply weld deposit on the inner surface of the reactor vessel. For the areas of perforation, aluminum patching plates were used. We successfully developed, build, deployed and used the tooling to effect repairs.

- The Calandria Inspection Tool (CVIT) was developed to perform inspections of the inside of the reactor vessel via an operator on the tooling platform located outboard of the reactor face. The CVIT tool consists of two RAD tolerant cameras, 1 colour with zoom capability, and 1 black and white. Initial inspections performed found debris located inside of the Calandria requiring the development of a Debris Removal Tool (DRT). Both tools are approximately 20 feet long and have articulating and telescoping arms. These tools can cover a 360 ° rotation and 100° arm flexion and are controlled by manual operations from operators located on the reactor platforms. The DRT has interchangeable scoops with the ability to pick up large items such as swab cloths, and the dexterity to pick up small items such as wires.

- *Intellectual Property/Patent Aspects*
  SNC Lavalin, CANDU Energy Inc., AECL and OPG maintain IP and some patent rights on remote tooling they have developed.