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

Technology Information	
Area	3 and 4 (Select the number from “Areas of Technologies Requested”)
Title	Freeze control and grabbing of harbor sediment and building water/debris
Submitted by	UK National Nuclear Laboratory (NNL)

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

Freezing of water associated with contaminated sediment can be used to prevent the movement of contamination in the environment (contamination suppression mats). The freezing of sediment can also be used to recover (or grab) secondary waste following effluent treatment. The technology has been developed by both the National Nuclear Laboratory and Studsvik, with both companies collaborating to deploy the technology in nuclear applications.

The technology works by using the water that surrounds particulates as a medium to entrap the particulates as ice forms. Freezing is achieved by passing a refrigerant around a circuit with ice forming on the outside of the circuit forming a frozen layer/grab. A variety of designs are possible ranging from designs aimed at bulk sediment removal, through to the recovery of fragments. A principal benefit is the fact that the ice prevents further movement or spread of contaminants that would be mobilized if the sediment were disturbed.

Waste ranging from sediment, ion exchange material, precipitated sludge, bricks, aggregate and fuel fragments have all been recovered using the technology in a variety of waste environments.

The technology is mature and can be deployed in a variety of environments and configurations. Supporting models exist to predict the rate of freezing and refrigerant requirements.

3 deployment opportunities are identified:

1. Control of sediment/contaminant movement within the harbor and subsequent recovery of sediment.
2. Recovery of secondary waste resulting from treatment of activity in the harbor.
3. Freezing of water and debris within reactor buildings to prevent further movement of contaminated water and to ultimately recover fuel debris.

Examples of materials resulting from deployment of this technology are shown in the following figures.

Figure 1 Frozen zeolite sample

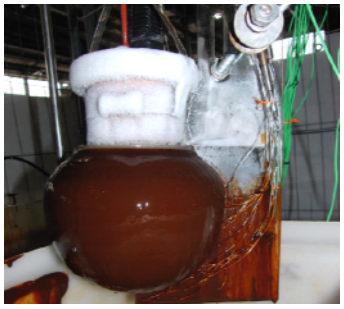

Figure 2 Frozen sludge

Figure 3 Frozen debris

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

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

Estimated Technology Readiness Levels.

- Technology readiness level 9 for recovery of sediment in marine cases.
- Technology readiness level of 6/7 for modified systems to meet the Fukushima harbor case (it is assumed that a slight modification of procedures will be required to account for the management of the radioactivity associated with the sediment).
- Technology readiness level of 3/4 for application within reactor buildings for the freezing of contaminated water and/or the recovery of fuel fragments that contribute the effluent activity. In this instance the relatively low TRL relates to the requirement to develop

remote handling technology for remote deployment in high dose environments (noting that studies have been concluded for much more complicated geometries).

- Challenges

Shielding considerations for the recovered sediment.

Remote deployment technology (for applications within high dose environment)

- Others (referential information on patent if any)

【Areas of Technologies Requested】

(1) Accumulation of contaminated water (Storage Tanks, etc.)
(2) Treatment of contaminated water (Tritium, etc.)
(3) Removal of radioactive materials from the seawater in the harbor
(4) Management of contaminated water inside the buildings
(5) Management measures to block groundwater from flowing into the site
(6) Understanding the groundwater flow