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

Technology Information	
Area	5 (Select the number from “Areas of Technologies Requested”)
Title	In-ground immobilisation measures for Strontium
Submitted by	UK National Nuclear Laboratory (NNL)

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

The rate of migration of Sr in groundwater varies according to the geochemistry and hydrogeology of the site. Commonly the rate of Sr migration is naturally attenuated through processes of sorption onto clay or iron rich minerals, and/or by incorporation into carbonate minerals. A number of potential intervention measures may be used to enhance the attenuation of Sr to the site soil, thereby reducing its migration rate. In this sheet measures are summarised which may be deployed via injection into the ground via boreholes. Two technology groups are available in this area:

One approach is to directly inject microscopic solid phase sorption materials, thereby increasing the number of available sorption sites, for instance:

- Micro-apatite;
- Micro-zeolites;
- Micro-zero valent iron;
- Nano-zero valent iron.

A second approach is to inject a mixture of aqueous phase chemicals (precursors) into the ground which then react and lead to precipitation of a specific Sr-incorporating mineral. Examples of this approach include apatite $Ca_6(PO_4)_{10}(OH)_2$ and calcium carbonate ($CaCO_3$) sequestration. Both of these methods are biologically mediated.

The performance of in-ground Sr attenuation measures is dependant on factors such as groundwater and soil geochemistry and site hydrogeology. As such, determining the most appropriate measure requires site-specific assessment. The NNL have a track record of laboratory, field and modeling assessment of Sr attenuation in contaminated groundwaters, both onto natural sediments and sorbent materials. This experience has been gained predominantly through study of Sr-90 migration at the Sellafield site in the UK.

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

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

These technologies have been developed into actual systems (i.e. TRL 8/9) at some sites in the USA. Sequestered apatite injection is the primary approach being used for Sr attenuation at the Hanford 100-NR-2 area.

- Challenges

Site specific performance e.g. naturally high Sr concentrations, high competing ion concentrations, rapid groundwater flow rates etc would reduce performance.

- 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