

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

Technology Information	
Area	5 and 6 (Select the number from "Areas of Technologies Requested")
Title	Hydrogeological studies
Submitted by	UK National Nuclear Laboratory (NNL)
<p>1. Overview of Technologies (features, specification, functions, owners, etc.)</p> <p>Understanding subsurface water movement (saturated and unsaturated zones) is fundamental to identifying options for managing groundwater and creating numerical models for risk assessment. This process starts with the investigation of sites to collect information that can be used to apply the principles of hydrogeology. The combination of information collected from measurements and the application of scientific principles can be used to develop conceptual and numerical models of groundwater systems.</p> <p>Basic data collected during site investigations include groundwater levels, contaminant distributions, aquifer types and dimensions, recharge and discharge locations, groundwater chemistry and groundwater gradients. There is a relationship between the amount of information that can be collected and the level of confidence that can then be given to resulting conceptual and numerical models. Additionally, comparisons between collected data and model simulations can be used to assess model performance and measure confidence and uncertainty.</p> <p>The NNL has considerable experience in investigating the hydrogeological characteristics of several nuclear sites including Sellafield, the Low Level Waste Repository in West Cumbria (LLWR), the Urenco site on the Wirral and the Radiana site at Kozloduy in Bulgaria. The NNL has been involved in the installation of monitoring wells, the operation of monitoring programmes, the collection of samples, the interpretation of data and the construction of conceptual and numerical models of groundwater flow and radionuclide transport.</p> <p>The Sellafield and LLWR sites are located on the Irish Sea coast where groundwater which partly originates in the hills of the western Lake District moves under the coastal region to the Irish sea. The NNL has carried out numerous hydrogeological programmes at these two sites including:</p> <ul style="list-style-type: none"> <li>• mapping groundwater plumes to understand groundwater flow and identify sources;</li> <li>• the use of borehole dataloggers to monitor water level and quality;</li> <li>• mapping and modeling rock fault lines to identify pathways;</li> </ul>	

- parameterising a soil water balance model to investigate repository performance;
- quantifying surface and groundwater balances to quantify natural and anthropogenic recharge;
- using tritium breakthrough curves to quantify groundwater flow velocities;
- using weirs to measure surface water flow rates and a soil water balance model to calculate evapotranspiration and apply these to catchment water balances;
- The design of a combined automatic river and groundwater level monitoring system using telemetry.



**A v-notch weir positioned in a chamber to measure leachate discharge from waste trenches.**

When collecting groundwater samples for laboratory analysis, the NNL always uses the low-flow technique where a selection of groundwater chemical parameters are monitored as the water is pumped from the borehole. This reduces the amount of water for disposal. Samples can be collected in 20 to 40 minutes per sample.



**Surveying a weir during the installation of telemetry to monitor river levels**

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 technologies for groundwater and surface water investigation are well-developed and almost always available off-the-shelf. However, it is recognized that Tepco have specified a particular requirement for non-intrusive investigation techniques. Because many hydrogeological techniques require drilling to access the subsurface environment for measurement and sample collection, non-intrusive techniques are not always available (e.g. for sample collection). Samples can be collected using automatic sample collection equipment and sensors connected to telemetry can be used to collect data without having to visit hazardous areas.

- Challenges

Particular challenges for hydrogeological investigations at the Fukushima site arise from the difficult surface working environment and the presence of significant surface and subsurface contamination in some areas. The collection of data from areas away from surface exposure to radiation would be desirable but where this can not be avoided, it would be preferable to collect water level and water chemistry data using sensors and telemetry.

- 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