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

Technology Information	
Area	6 (Select the number from "Areas of Technologies Requested")
Title	Understanding the Groundwater Flow
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1. Overview of Technologies (features, specification, functions, owners, etc.)

Drilling boreholes around the buildings requires protective clothing and shields and takes therefore too long.

The geological parameters will be reasonably similar at distance from the buildings. To reduce drilling costs/time, one solution is to drill boreholes at the up hydraulic gradient site boundary, or up gradient offsite, where the Health and Safety measures can be reduced, thus reducing drilling time. Drilling in this area (we recommend fully logged and cored boreholes) will provide information on the Tomioka layer. A cored borehole, will provide information, if properly logged, on fracture patterns as well as changes in sand or silt grain sizes. This in turn will provide evidence on whether the Tomioka layer has dual porosity (both fracture and intergranular flow) and variable permeability (via varying pore sizes as well as fractures and fissures). Other techniques, such as permeability tests (variable head tests, packer tests) or impression packers to look at fracturing, can then be carried out. Given the seismic nature of Japan it would seem very likely that this aquifer is dual porosity, with flow through preferential fracture horizons and faults.

The problem is that many of the geological and hydrogeological parameters that effect flow below the site and into the buildings are unknown.

Boring has been carried out which has identified bulk properties, more detailed investigation is required as groundwater flow may be within preferential pathways which means that a cryogenic barrier or hydraulic barrier can be made much more specific and less extensive to achieve the prevention of flow onto site.

As well as the construction of good boreholes and in-situ testing (see above), the area could be geophysically surveyed to obtain a better understanding on the Tomioka layer and preferential flow. Electromagnetic techniques or ground penetrating radar could identify changes in lithology and resistivity has long been used for aquifer definition. Again these techniques could be employed at the up-gradient boundary and outside the site to obtain an understanding of the onsite geology.

Many tests for assessing an aquifer would not be recommended. Pumping tests may "pull" contaminated groundwater into uncontaminated areas. Whilst tracer tests could also be used to study groundwater flow through the site, in the current political debate, these might not be considered to be suitable.

The pumping around the buildings has to remove 400m^3/day of groundwater which has to be treated

This could be decreased with a full understanding of the hydrogeological and hydrochemical parameters. Increased permeability layers could be pumped at the site boundary, if concentrations of radionuclides are at "background" then discharged into the rivers. There are then no treatment costs, only piping costs to the river and clean groundwater is discharged. Therefore removing the water prior to it becoming contaminated is paramount, and politically if at the boundary or before, prevents the current discussions over disposal at sea.

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

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

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Rock coring techniques, packer testing and geophysical techniques are widespread.

- Challenges

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Access to offsite land.

- Others (referential information on patent if any)