HOW LOCATING A NUCLEAR WASTE REPOSITORY INLAND MAY INCREASE ITS SAFETY

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The use of multiple barriers to permanently isolate high-level nuclear waste in a subsurface repository remains an essential element of the system to be implemented in Sweden. There are two main elements: the first barrier, the engineered barrier, consists of the ceramic nuclear waste fuel rods within a metallic container surrounded by a layer of dense clay. Should the unlikely event of engineered barrier failure somehow occur, escaping toxic radionuclides would enter the second barrier system, the natural hydrogeologic barrier. These radionuclides will migrate with the flowing subsurface water toward the places where this groundwater discharges to the surface environment or to surface water bodies. It is hoped that most escaping radionuclides would adhere to the bedrock and be held back to such an extent that they would have time to decay to harmless levels before reaching the surface – and this retention and delay is the primary isolation provided by the natural hydrogeologic barrier. The other function of this barrier is to provide a permanent stable environment that will allow the engineered barrier system to function as designed.

The international principle of containment system 'optimization' might necessitate that each component in the multiple barrier isolation system be optimized for the isolation and safety that it will provide, should the other components fail. However, 'optimization' is not an absolute requirement as it implies that the safety added by extra effort needs to be weighed against the additional cost of that effort. For the hydrogeologic barrier, 'optimization' may motivate the selection of an appropriate inland location for the repository, if one could be identified, should this also be a socially- and economically-feasible option. An appropriate inland location would be below a regional groundwater recharge area, where any escaping radionuclides would follow extremely long and deep subsurface paths before discharging at the surface. The result would be relatively low doses to the environment. In contrast, a nuclear waste repository located within a ground-water discharge area has very short paths, possibly allowing escaping radionuclides to reach the surface in a short time allowing much higher doses to the environment.

In Sweden, as in all locations worldwide, most coastal areas are within or near the primary discharge areas for regional ground-water flow. This would lead to the expectation that a coastal repository may provide a lower margin of the hydrogeologic safety component in the multiple-barrier system than a repository located below a major inland recharge area.