The Swiss Concept: Container Design and Transport of L/ILW to the Planned Final Repository

J. Migenda, A.L. Nold
GNW c/o NAGRA, National Cooperative for the Disposal of Radioactive Waste

INTRODUCTION

In June 1994, an application for a general license for a final repository for Low and Intermediate Level Waste (L/ILW) was submitted to the Swiss Federal Government. In June 1995, a referendum at the cantonal level was held as to whether to build the repository in Wolfenschiessen, the proposed host in Canton Nidwalden. The outcome of the referendum was negative; the people of the Canton voted against the repository by 52 % NO to 48 % YES. At the national and communal levels there is agreement with the choice of the Wellenberg site; the strategic and legal issues thereby raised are still under discussion. However, GNW, the company formed for construction and operation of the repository, regards Wellenberg as the preferred site in Switzerland for realization of this national project.

The proposed location for the repository at Wellenberg, in central Switzerland, 25 km south of Lucerne in Canton Nidwalden, is illustrated in Figure one.

The repository is designed to take all operational L/ILW from the five Swiss nuclear power plants (3 GWe), low-level reprocessing waste, waste from medicine, industry, and research and decommissioning waste from all nuclear facilities. The total projected volume of L/ILW is approximately 125,000 m^3, derived from a model waste inventory data bank which itself includes larger waste volumes to allow for planning reserves (see Table 1). The inventory scenario is based on a 40-year lifetime for all five operating Nuclear Power Plants (NPPs); it does not at present consider further use of nuclear power after the year 2024.

Two operating phases of the repository are planned: one starting approximately in the year 2010 and lasting until 2021 and the second from about 2027 until 2042. The time gap between the operating phases is necessary to allow construction of the second set of disposal caverns. In phase 1, mainly operational waste from the nuclear power plants and waste from medicine, industry, and research in the form of 200-l drums (approximately 60,000 drums), as well as reprocessing waste will be emplaced in the facility. Phase 2 is principally foreseen for emplacement of decommissioning waste (approximately 80,000 m^3) and reprocessing waste returned from foreign facilities.

CONTAINER CONCEPT

Transport Container

The transport container concept is based on a set of reusable containers for transporting 200-l drums and reprocessing waste to the final repository. The transport containers are designed to hold a maximum number of waste packages in order to minimize transport to the repository and to simplify handling operations. Most of the transport containers have standardized dimensions and corner fittings which are based on ISO dimensions (see Figure 2). The handling tools reflect standardized ISO technology, which has been used repeatedly for handling ISO freight containers.

The surface dose rate of the waste drum determines which container type will be used for transport. There are transport containers that are designed to allow a dose rate up to 10 Sv/h at the waste drum surface. With one exception, the containers are designed as type IP-3 industrial packages in compliance with the 1985 IAEA Safety Series No. 6 Regulations, as amended in 1990. One transport container, a GNS Mosaik II, is designed to meet the requirements of a type B (U) package. The construction materials of all these types of containers are steel plate, cast steel, or ductile cast iron.

The unloading of the 200-l drums from the transport containers is done with a special handling tool which can handle nine drums at a time.

Final Disposal Container

The final disposal containers (EC containers) are designed to hold either 200-l drums or decommissioning waste (see Figure 3).

The EC containers holding 200-l drums are used for disposing of the 200-l drums in the repository caverns. The EC containers are filled remotely with 200-l drums in the preparation facility of the operations cavern. The void volume of the concrete container loaded with drums will then be filled with a porous mortar. Thereafter, the concrete container will be moved by air cushion platform into a concrete-hardening position outside the preparation facility. After hardening, the container will be lifted by an 80-t capacity overhead crane onto the internal rail system and brought to the final storage cavern.

The EC containers holding decommissioning waste are designed as dual-purpose transport and disposal containers in compliance with the 1985 IAEA Safety Series No. 6 Regulations, as amended in 1990. The construction material of the final disposal containers is concrete. The maximum weight for a single loaded container is 80 t.

REPOSITORY DESIGN

The repository consists of a system of tunnels and caverns that will be excavated into the mountain. The repository will be accessed from the valley floor through a horizontal access tunnel. Most of the repository facilities will be inside the Wellenberg, except for an administration building and the air intake and exhaust air outlet which are located at the surface (see Figure 4). The repository comprises the access tunnels, the reception facility, connecting tunnels, and the final storage caverns. The reception facility is divided into a waste transfer cavern, an operations cavern, and an auxiliary cavern. The operations cavern hosts the central control room, from where all handling and storage operations will be remotely controlled and monitored by video cameras.

Figure 5 shows a schematic figure of the repository facilities inside the Wellenberg.

TRANSPORT CONCEPT

The repository can be reached by rail or road, with rail transport being the preferred mode of transportation.

Transport by rail will take place from the NPP or interim storage facility via Lucerne to Wellenberg. The locomotive will haul the railcars directly into the transport reception area of the repository. Thereafter, the GNW locomotive will bring the railcars to the transfer cavern of the repository.

The number of transport operations to the repository will be between 140 and 170 per operating year (approximately three to four rail transports per week) and will depend on the number of railcars in each consignment.

In the reception facility there will be a switch from the external to internal transport system. The modes of transport for the packages inside the repository include overhead cranes, air cushion transport for precise maneuvering in limited spaces, and internal rail transport. The routine transport weight by rail is 56 t and for nonroutine transport 80 t (maximum).

CONCLUSIONS

The design of the Swiss repository for short-lived L/ILW is based on a specifically developed container and package concept.

The preferred mode of transportation to the repository will be by rail. The routine transport weight by rail is 56 t and for nonroutine transport 80 t (maximum). The transport of drums and reprocessing waste will be in reusable steel containers and that of decommissioning waste in dual purpose transport and disposal containers.

Most of the containers have standardized dimensions and corner fittings which are based on ISO dimensions. The modes of transport for the containers and packages within the repository include overhead cranes, an air cushion platform for precise maneuvering in limited spaces and internal rail transport. The handling and transport will mostly be remotely controlled and monitored by video cameras from the control room. Hence, the exposure times of the operating personnel in the radiation environment are minimized.

Figure 1. Proposed Site for the Swiss Final Repository for L/ILW at Wellenberg

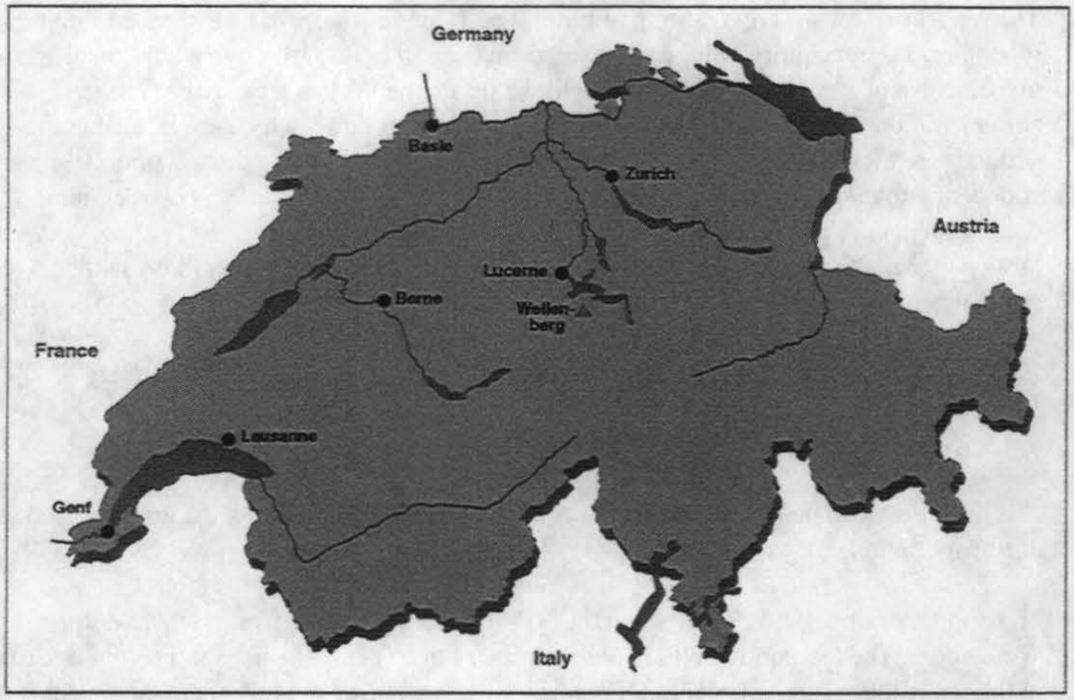

Table 1. Model Radioactive Waste Inventory for the Swiss Final Repository

Waste Sorts	Waste Volume (m³) ODL * < 2 mSv/h	Waste Volume (m³) ODL * > 2 mSv/h	Waste Volume (m³) Sum	Number of Packages	Remarks
Operational Waste NPP	5'320	5'530	10'850	50'000	200-l Drums
Waste from Medicine, Industry and Research, (MIF)	5'300	3'500	8'800	38'350	200-l Drums and some PSI-Container
Concrete Shielded Container (BA-C)	200	0	200	205	
Reprocessing Waste CAC BNFL	 6'500 17'500	 0 0	 6'500 17'500	 9'700 14'770	
Non-Fuel Reactor Core Waste (RA) in 200-l Drums, Mosaik, SA-Container	1'800	500	2'300	2'300	200-l Drums
Decommissioning Waste (SA) SA-NPP SA-PSI Sum SA-NPP/PSI	 65'000 14'500 	 0 0 	 65'000 14'500 	 3'450	Final Disposal Container
TOTAL (m³) TOTAL (Number of Packages)			125'650	 118'775	

* ODL = Dose Rate at the Package Surface, Values are at the Time of Production.

Figure 2. Transport Container Concept for the Swiss L/ILW Final Repository

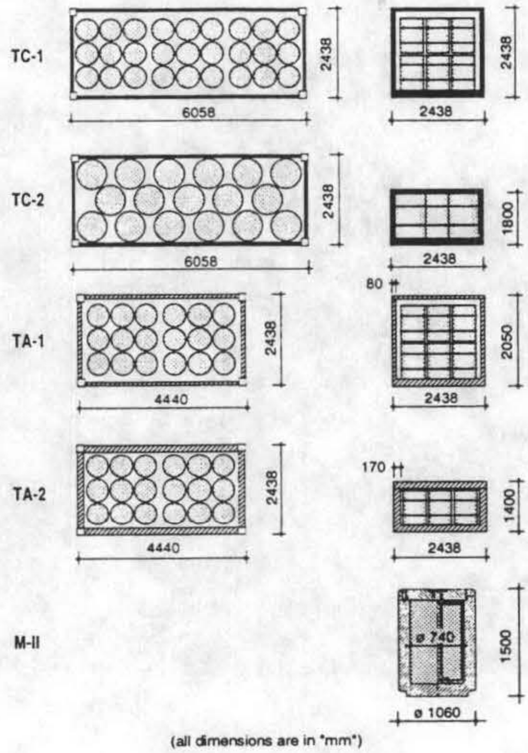

Figure 3. Final Disposal Container Concept for the Swiss L/ILW Repository

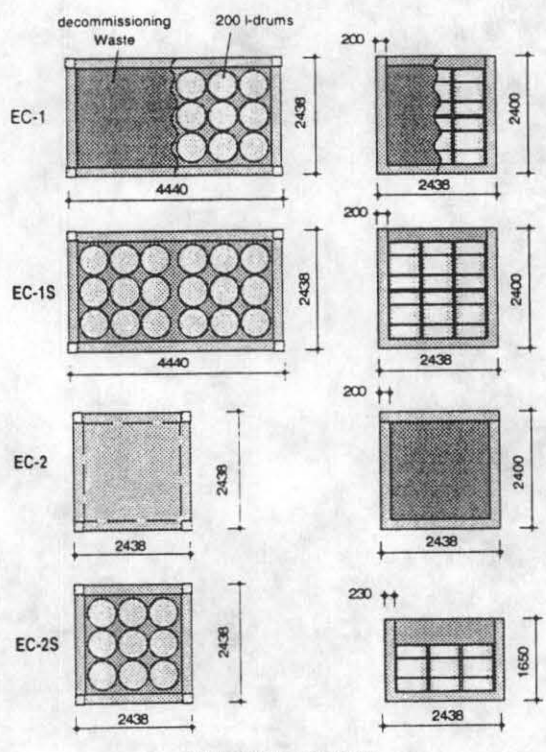

Figure 4. Schematic Figure of the Repository Facilities at the Portal Zone

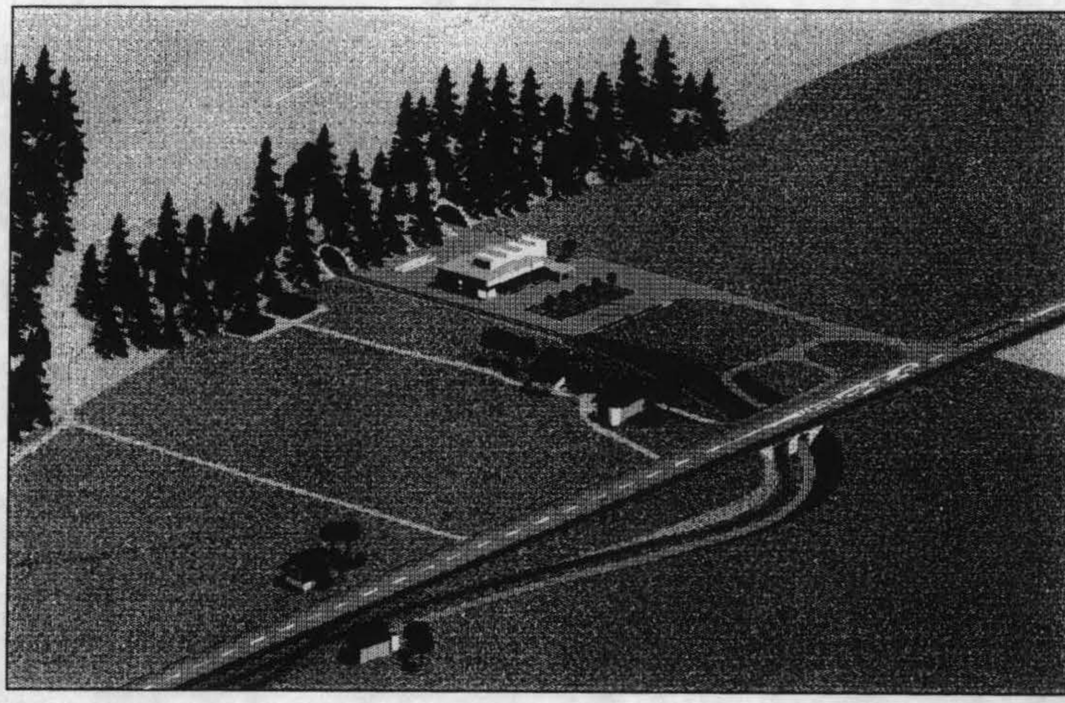

Figure 5. Schematic Figure of the Repository Facilities Inside the Wellenberg