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Management of Low and Intermediate Level Wastes

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Teollisuuden Voima Oy (TVO) operates two 840 MWe BWR units (Olkiluoto-1 and Olkiluoto-2) on the west coast of Finland. The commercial operation of Olkiluoto-1 began in 1978, and of Olkiluoto-2 in 1980.

The plant units have already been in operation for 20 years but a lot of operational years still lie ahead. That is why plant units have been modernized during the 1994-98 period, to be sure that there will be at least 40 years of operating lifetime ahead. At the same time, the power uprating of the units from 710 MWe to 840 MWe has been completed.

TVO, as a waste producer, is responsible for the safe management of its own waste produced at Olkiluoto. The final disposal facility for low and intermediate level operational waste, the VLJ-Repository, was commissioned in May 1992.

Description of the VLJ-Repository

Excavation of the repository was started in 1988 and the test operation of the repository was technically completed in 1991. The repository is located at the plant site, less than one kilometre from the plant units (see Figure 1).

The repository is situated at the depth of 70–100 metres in crystalline bedrock. It has two separate silos, one for low level and the other for intermediate level waste (see Figure 2). The total capacity of the silos is about 40 000 drums (200 litres each) corresponding to the accumulation of waste over 40 years of operation.

The waste drums are packed at the power plant in concrete containers, each containing 16 drums. Containers are transported to the repository inside a steel shield two at a time by a special vehicle. The containers are self-supporting and are placed in the silos without any other supporting structure. The containers are lowered from the crane hall into the silos by a remote controlled overhead crane. The construction costs of the repository and the costs of the vehicle and two transport shields were FIM 85 million (about US$18 million).

As regards the decommissioning of the plant units, it is possible to build additional repository facilities in the same area for decommissioning wastes.

Operational Experience

Personnel

One of the main goals while planning the repository was that the handling of waste and the operation of the repository must be so easy that there would be no need to employ any additional staff for that purpose. We succeeded in achieving this. The group of staff that had taken care of waste and fuel handling is now also responsible for the transportation and handling of waste containers and the operation of the repository. There is no permanent staff in the repository.

Each transportation campaign lasts one and a half days, including the loading of concrete containers at the plant units, transportation of containers to the repository, lowering of containers into silos, and the keeping of records of the waste packages. Persons in this waste and fuel handling group are so multi-skilled that most of them can by themselves take care of an entire transportation

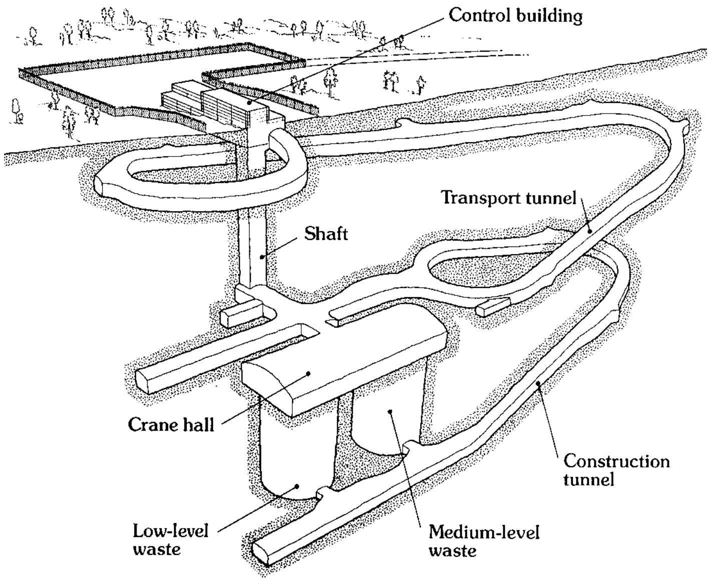

Figure 1. The VLJ-Repository at Olkiluoto.

campaign, including also all essential health physics activities. The annual accumulation of disposable waste is about 150 m^3, which means roughly 20 transportation operations per year. One person can do this work in 1.5 months.

The VLJ-Repository is under the supervision of Olkiluoto-1 control room personnel. All alarms come to this control room, and the control room staff make daily control trips to the repository outside normal working time.

Transportation

Transport between the plant units and the VLJ-Repository is done by a terminal vehicle, as commonly used in harbours, which is specially modified for this purpose. The vehicle has more effective brakes, to avoid serious collisions with the rock in the sloping transport tunnel, and the brakes are equipped with fire extinguishers. The vehicle has a transport platform that can be raised and lowered hydraulically.

The transport shield, which houses one or two concrete containers, is on the platform. The transport shield fulfils the requirements for radioactive material transport on public roads, except for the dropping test. There are two shields to make the transportation flexible. One shield is in the waste storage area of the power plant, for loading the barrels and containers, and the other is in the repository, for unloading.

The vehicle and transport platform are designed so that they can also be used for other purposes, such as transporting spent fuel transfer casks from the power plant to the interim storage area, and for transporting other heavy components.

Waste Types and Packages

Compressible maintenance waste and solidified liquid waste are packed in 200 litre drums. Incompressible waste and bigger metallic components are packed after volume reduction in 1.5 m^3 metallic boxes, or in the concrete containers directly. Filter cartridges and ventilation filters are also packed in these metallic boxes, which are further placed in the concrete boxes for final disposal.

Volume reduction of the 200 litre drums and the bigger metallic components like tubes is done by a compactor with a power of 200 tonnes. The volume of a 200 litre drum can be reduced by half. The compactor itself was designed and manufactured by a local company, from a design for a conventional press used in the metal industry. The price of the compactor (US$100 000) was very low compared with so-called super compactors. The volume reduction is adequate for our purposes.

These waste types are called low level waste and they are disposed of in the low level waste silo. The only intermediate level waste is bituminised ion exchange resins from the water clean-up systems. This waste is packed in 200 litre drums and disposed in the intermediate level waste silo.

Operation

All operational, control and follow-up activities of the systems in the repository are computerised. For example, lighting, ventilation and doors are controlled, activated and switched off by a computer. There are no push buttons. It is very easy to get various operational data and statistics

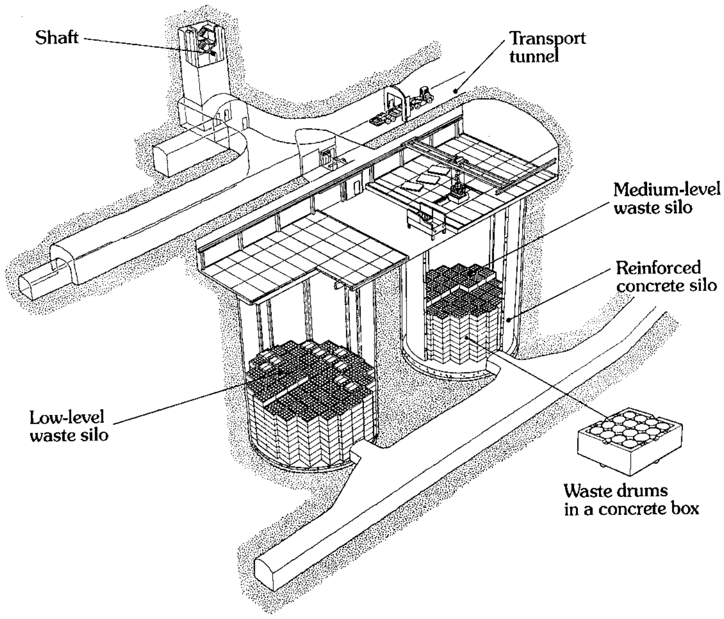

Figure 2. Enlarged view of the waste silos in the VLJ-Repository.

from the computer.

Handling the waste packages and the concrete lids of the silos is done by remote control from the control room. On the crane bridge there are six cameras which provide the control room operator with general view of the crane hall, all four sides of the waste container, and the position of the bridge and van if necessary.

Each camera has a display in the control room. The main display of the control panel presents the position of the crane, the chart of the silo, the address (co-ordinates) of the waste canister being handled, the height of the canister being lifted, the twist of the lifting wires, the weight of the canister's four corners (there is one wire on each corner), and the total weight of the canister. The crane is designed and manufactured by the Finnish KONE-lift company. The operators have been very satisfied with the crane and the automation systems.

The record keeping system for the waste packages is also computerised. The system includes information about the updated nuclide specific activity of each package (drum, box, container), the content of each package, packaging date, disposal date, and the address of each package (x, y and z co-ordinates). Each package can be identified by a code number on its surface.

Waste Volume and Activity

Almost all the waste accumulated during the 20 years of power plant operation has been transported into the repository. There are altogether 473 concrete containers in the low level waste silo, and 319 containers in the intermediate level waste silo. Up to the present, 30 % of the low level waste silo's capacity and 28% of the intermediate level waste silo's capacity have been used. This means that there is still enough space for the waste expected to accumulate during a further 45 years of operation.

In the Final Safety Analysis Report for the repository, the maximum limits for nuclide specific activities in the repository were set out. At present, the nuclide specific activity content is much smaller than the volume percentage used so far would allow, except for Ni-59 and Ni-63. The activity of these two nuclides is about 34% of the maximum allowable limit. The activity of nickel has been calculated theoretically from the activity of Co-60. Nickel is thus the limiting nuclide for the length of the repository's operation.

Could the Repository Have Been Designed Better?

The concrete canisters used as disposal packages are flexible, because drums, boxes and large pieces of waste can be placed into them. There is, however, one problem. Big metallic tanks and heat exchangers must be cut into small pieces before being placed into the canisters. This work is time consuming, expensive and difficult. It would be more attractive to place such big tanks into the repository directly, allowing them to function as waste packages. The repository would have needed a separate silo or tunnel for this purpose.