CLOSURE PLAN OF AN OPERATION AT LILW REPOSITORY IN SOUTH AFRICA

1. Background

Vaalputs, the South African, National Radioactive Waste Management Facility, is situated in an area of the Northern Cape Province and is operated by the Atomic Energy Corporation of South Africa Limited. Screening and site selection lasted from 1978–1984, construction took place from 1984 to 1986.

The waste received is predominantly from the Koeberg nuclear power station and low and intermediate-level radioactive waste is disposed of in a near surface disposal facility in clay. Two trenches were excavated for use, one is used for concrete containers and one for other waste, mostly compressed trash in 200-liter drums. No capping of trenches has taken place as it was originally anticipated that the trenches would be capped after being filled. Much slower delivery of waste packages and other problems has led to a process of temporary capping.

2. Regulating requirements

There are no formal regulatory requirements specifying the cap design, however, it is required that overall cap requirements will minimize risk to humans and the environment from the repository and will maintain its integrity during all possible anticipated weather conditions during the periods of operation and institutional control.

3. Systems

3.1 Site

The screening phase commenced in 1979 on a national basis and included the parameters, i.e. climate and rainfall, agricultural density, population density, ecologically sensitive areas, mineral occurrences, surface and ground water, seismic hazards, industrial ground potential and proximity to international boundaries. A few sites were identified and the site-selection phase which involved regional and semi-regional geological, geohydrological, geophysical and other earth science related studies. A site was selected where there was an area underlain by approximately 20 m of clay. The area is covered by a veneer of calcrete and windblown sand and overlies a granite-gneiss suite.

3.2 Design

Two trenches 100 m × 20 m × 7.5 m deep were constructed. One trench was to be used for concrete containers (Figure A.7) and the other for metal drums. The clay layer is very stable and the walls of the trenches were constructed at an angle of 10^{o} from the vertical. The cap for the trenches would be constructed from the same clay and sand material that was removed from the trench. Different layers of the soil were kept separate during the excavation phase. Screened clay with a moisture content approximately 5% is used for backfilling between the containers.

The top 2–3 meters of the trench consists of the trench cap (Figure A.8). The screened clay will be compacted in layers 150 mm thick and will have a slight slope from the center of the trench to the sides. Compaction, permeability, moisture storage capacity, shrinkage and elasticity laboratory tests were performed. The moisture content of clay for the compaction process was found to be ± 13 %. This value is just on the dry side of optimum for compaction purposes, to provide increased water storage capacity. The water in the clay will then be available for evapotranspiration. The original sand will be placed over the compacted clay to a minimum of 300 mm. Vegetation from the area will be replanted on the trench and it is anticipated that micro irrigation will be used till the vegetation is established after which the irrigation will be discontinued. Vegetation in this area is mostly small bushes, while grass is almost non-existent.

3.3. Performance assessment

Water storage capacity tests and calculations showed that 300 to 400 mm of rainfall, which is 4 to 5 times the annual rainfall for the area, could be absorbed by the cap. Experimental caps that were constructed for performance assessment satisfactorily prevented rainwater infiltration into the trench during a 1 in 100 year rainfall event that occurred during December 1985.

Delivery of waste was much slower than originally anticipated and some concrete containers developed cracks and some metal drums corroded. It was believed that both of these effects were due to the waste packages being exposed to the elements for much longer than anticipated. When waste packages are in place, a wall of concrete blocks was built across each trench. It is intended to construct a cap over the packages and up against the wall. Concrete blocks were also used to construct small disposal modules.

The smaller compartments in the trench will be temporarily covered. These temporary caps will be 0.3 to 0.5 meters thick consisting of a 150 mm sandy clay layer on top of the waste packages, followed by a 1 or 1.5 mm geomembrane, and a clay cap on top of that of approximately 200 mm. The geomembrane will overlap the concrete wall and joint welded on to the next compartments geomembrane.

3.4. Site intrusion

Human intrusion

Due to poor natural resources, the acid climate and prolonged low population density, the site is of low growth potential. Human intrusion is therefore not considered as of any significance.

Animal intrusion

Various burrowing species occur on the site or its vicinity and are being decided as part of an on-going programme to investigate possible disturbing agents. The common harvester termite poses the greatest potential impact on the disposal trenches. It has the ability to excavate to depths in excess of 9 m, which is below the trench floor. Due to the plugging effect of soil slurry, water will not penetrate the termite burrow. The possibility exists that radioactive contaminants on sand particles could be brought to the surface by the termites. The termite activity is most severe in denuded areas typical of the trench cap and it could

adversely affect the revegetation programme as their diet consists primarily of dry grass. Experimented revegetation work on the caps of the experimental trenches has proved successful and the results of these studies will be applied to the actual trench caps. Any effects due to burrowing agents are expected to be slow and to occur in the medium to long term. The situation is monitored on an on-going basis and, if necessary, the activities of any burrowers will be curtailed by conventional means.

4. Procedures

The excavated soil from the trench is dumped in 3 different areas, sandy topsoil, calcrete and clay. The calcrete is screened and used on the bottom of a trench for a drainage layer. The clay will be screened and then spread out over an area about 150–200 mm deep, wetted and mixed by mechanical equipment. Clay with the dried moisture content is placed over the containers in the trench, levelled and compacted. It is anticipated that a compaction density of 1, 700 to 1, 800 kg/m^3 will give a permeability in the order of 1×10^{-5} cm/s.

5. Technologies involved

The waste repository is in an arid area, therefore, the cap design employs the resistive barrier concept of a low permeability layer, as well as a vegetation cap to protect the cap against erosion. The vegetation cap is also plays an important roll in removal of soil moisture by transpiration.

6. Quality assurance

A quality assurance program to ascertain that design specifications are met and that construction work is done according to approved procedures will be in place before the construction of the cap starts.

7. General

7.1. Public acceptance

The policy of the AEC is to keep the public involved in all of its activities as far as possible. There are a number of public organizations, selected by the community, that meet regularly with the AEC to give feedback to their constituents on AEC activities. They are: (1) The Pelindaba Communication Forum; (2) Vaalberg Trust; (3) Local Farming Association in Springbok (near Vaalputs); and (4) Local Fence Committee (Vaalputs area).

7.2. Cost

Estimated cost of capping the Vaalputs trenches with clay layers and sand topsoil is approximately $ 50 /m^3 (U.S.). Introducing a geomembrane will increase the cost with $ 10/m^3.

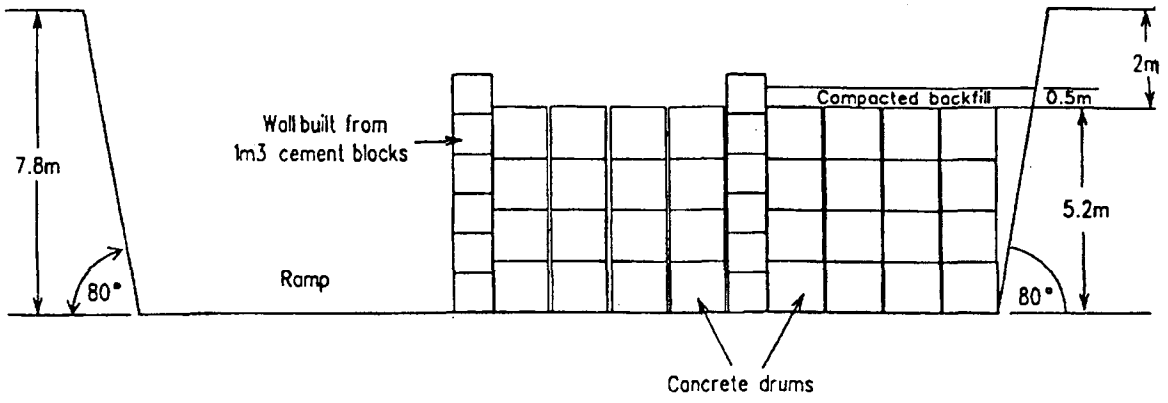

FIG. A.7. Cross-section through proposed disposal modules (South Africa).

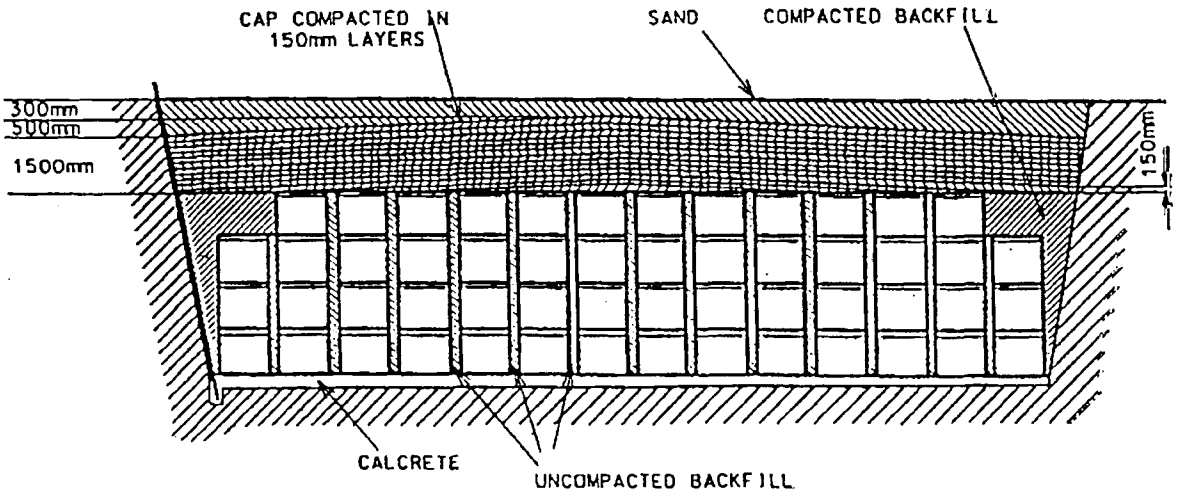

FIG. A.8. Detail of backfilling and cap construction (South Africa).