LOW LEVEL WASTE REPOSITORIES

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Earlier speakers in this symposium talked about:-

- Synroc and its implications for high level waste disposal
- Management of radioactive waste from uranium mining and milling
- Impacts of uranium mining on the environment

The speakers have already covered a number of issues that apply to the design and maintenance of low-level waste repositories. To go over the ground again would be repetitious and this paper is restricted to the rather narrow band of low level waste disposal issues not already discussed.

Low Level Waste

Rometsh (*1) defines low level waste as material with a specific alpha activity of:-

- an upper limit of 1.0×10^{-1} Curies/cubic metre 37×10^{6} Bq/litre
- a lower limit of 1.0×10^{-9} Curies/cubic metre 3.7×10^{-2} Bq/litre

A broader definition is given in the I.A.E.A. Safety Series No. 53 (*4):

- Those wastes which because of their low radionuclide content, do not require shielding during normal handling and transportation.

In practice, low level waste is often material "perceived" as low level waste rather that material of any given specific level of activity.

The unwanted material is sent to a repository to get it out of sight and out of mind.

Low level radioactive waste can be generated from a multitude of human activities including:-

- hospital sources
- industrial sources
- military activities
- uranium or thorium exploration, laboratory examination and processing.

Fear of low level radioactive waste

Fear of possible health effects from radiation, has led to public pressure on Governments to consider low level waste disposal as a separate issue to the normal disposal of industrial waste and garbage.

In 1981 the State Government set about finding a suitable site to dispose of low level waste material.

SELECTING A SITE FOR LOW LEVEL WASTE REPOSITORY

It is suggested that seven main considerations should be taken into consideration when selecting a site for a low-level waste repository.

- no occupied dwellings within a calculated distance (plus a buffer zone) of the proposed repository
- an area where the background radiation is naturally relatively high
- ready accessibility to a good all weather road or railway
- climate
- topography
- groundwater
- cost

No occupied dwellings within a calculated distance (plus a buffer zone)

Mr. Fry in his paper produces a table suggesting that at 3 km from a tailings burial site the airborne radon daughter levels can be expected to be extremely low. A buffer zone beyond the 3 km may still be considered necessary for visual screening or "peace-of-mind" purposes.

An area where the natural background radiation is relatively high

As geoscientists you will be aware that some granite and pegmatite areas can have background readings in the order of 0.6 µGy/hr. In contrast, swamp areas or areas with a muddy soil may be in the order of 0.07 µGy/Hr.

Schedule 9 of the Australian "Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores" 1980 suggests an above background of limit of 0.6 µGy/hr for members of the public (based on 168 hours/week exposure).

It would be relatively easy to dispose of low-level waste in granite country because most of the low level waste would be below background. It would be progressively more difficult to observe the Code and the principles of dose limitation in a muddy soil area.

At Radium Hill, the ridge along the strike of the old mine site had readings as high as 14 μGy/hr and the general background around the mine was 0.5 to 1 μGy/hr. A geological area of high background readings.

Ready accessibility to a good all weather road or railway

Further advantages follow if the waste can be of off loaded from the transport vehicle directly into the repository without the need for rehandling.

Climate

In tropical climates where the precipitation exceeds the evaporation for all or part of the year, the design of the repository will probably be quite different from a dry mediterranean climate.

In a wet climate it may be more desirable to dispose of low level waste under water, in a deep lake or in an ocean trench.

In a dry arid climate above ground storage with eventual burial and rock covering may be the most stable alternative.

Topography

The topography will, in any event be site specific. Selection will depend on a number of factors e.g.:

- steep or flat country
- clay material for sealing the base of the repository and for burial cover
- flood protection
- wind erosion
- fauna and human protection

Groundwater

Groundwater, to some extent, has been covered by other speakers.

Sufficient to say a careful groundwater study is necessary of the site and every precaution should be taken to prevent seepage. If seepage does occur it should be prevented from entering and polluting useful groundwater.

Cost

While cost is given last on this list, it is not the least important.

Perhaps the concept of designing low grade waste repositories or mine tailings dumps for 1 000 years might be a good topic for the discussion groups later in the afternoon. With 13% money and discount time of 1 000 years, the use of discounted cash flow calculations to justify building a long life Taj Mahal is difficult. The problem falls outside the normal range of mine evaluation studies.

SOUTH AUSTRALIAN LOW LEVEL WASTE REPOSITORY

The State Government decided in 1981 to rehabilitate the Radium Hill uranium flotation tailings dams, and to make use of the dams as a repository for low level waste. Nineteen years after production ceased the No. 1 tailings dam had weathered on the top and runnels had developed on the sides. On a day of strong wind, fine grained schistose tailings fanned out over the surrounding pastoral property.

During rehabilitation the No. 1 and No. 2 tailings dams were covered with 1 metre of compacted clay and the sides of the dams were encased in a dam of compacted clay 9 metres wide at the base tapering to 3 metres wide at the top.

To date, approximately 10 semi-trailers of exploration core and laboratory tailings have been buried. The space in the top No. 2 dam is expected to be adequate for at least the next 25 years and can be extended for a much longer term by additional simple earthworks.

The outside of the tailings dam is not armoured, merely coated with 3-9 metres of compacted clay. The budget did not run to armouring. To be realistic, some maintenance will be necessary at intervals of about every 20 years. The budget cost of the rehabilitation and construction of roadworks and repository and rehabilitating the tailings was $200 000, the actual cost $156 000. Armouring would have cost in excess of another $50 000.

Statistics of the operation

Size of tailings dump	400 000 m^3
Amount of clay used	75 000 m^3
Mine area background readings	0.5-1.0μGy/hr
Readings on top of the tailings before covering	0.6-1.0μGy/hr av 0.8
Readings after covering	0.1 to 0.4μGy/hr av 0.2
Reading above buried drums of low-level radioactive waste	0.1 to 0.4μGy/hr av 0.2
Nearest dwelling	15 km
Rainfall	variable, av. 300mm/year

Transport of low level waste

The low level waste is transported to Radium Hill in convoys consisting of:-

- two semi-trailers
- one light four wheel drive vehicle

A small front-end loader is carried piggy-back on one of the semi-trailers.

The convoy proceeds towards Broken Hill along the bitumen, turning at Cutana siding and proceeding for 15 km on an upgraded dirt track to Radium Hill. At Radium Hill the semi-trailers are driven up a 1:9 gradient ramp to the top of No. 2 tailings dam. The drums are offloaded by the front-end loader and stacked on pallets in the burial chamber. On completion, one metre of fill is bulldozed over the drums, and lightly compacted.

HOSPITAL WASTE

Traditionally Hospital waste has been disposed of in Council rubbish tips. Very small quantities of Hospital waste are diluted by large quantities of rubbish. The radiation enhancement of the total rubbish mass is probably too low to be easily measured, and if it can be measured may be attributable in part to other low activity material in the rubbish.

OLYMPIC DAM

A local low level waste storage area has been established by the Joint Venturers at Roxby Downs.

The ore reserve drilling at Olympic Dam over the last seven years has been substantial and amounts to some hundreds of kilometres of diamond drill core of which perhaps two thirds is mineralised. The mineralised sections of core typically contain 0.002 to 0.12% U_3O_3 and averaging .08% U_3O_8.

The core is split with a diamond saw, half retained in DD core trays, other portions are prepared on site and sent for assay.

The amount of low level waste generated is substantial and far outweighs generation from other sources in South Australia. More low level waste is disposed of at Olympic Dam than at Radium Hill.

The low level waste is buried in specially prepared trenches near the Whenan Shaft.

- trenches are dug 3 m deep and 30 m long
- the low level waste is backfilled to a depth of 2 m
- the low level waste is covered with 1 metre of sandy clay
- the area is within a Retention Lease. The lease area is sufficiently large to give a buffer zone around the storage.

Once covered, the surface low level Gamma radiation reads about 0.02 μGy/hr above badkground.

Background is .04 to .07 μGy/hr.

The groundwater in the area is:-

. 55 metres below the surface area

. contains 35 000 ppm total dissolved solids

. naturally contains 2 to 10 Bq/litre of dissolved Radium

. moves slowly towards Lake Torrens with salinity increasing towards 100 000 ppm T.D.S.

To date, the third trench is now being filled.

CONCLUSION

1. The cost of low-level waste disposal can be minimised by careful consideration of requirements for the site.

2. South Australia has been fortunate in so far that the sites selected are:-

   - in sparsely populated areas
   - have stable topography and climatic conditions.

1) 'Nuclear Waste Management in Switzerland'
R. Rometsch. IAEA Bulletin Vol. 24, No. 2,
June, 1982.

2) AMDL 64, Project 1/8/1, SADM
Retreatment of Radium Hill Tailings Dumps
Second Report
Pilot Plant Tests D.G. Sheridan, P.K. Hosking
October, 1960

3) Roxby Management Services Pty. Ltd.
Olympic Dam Project
Draft Environmental Impact Statement
ISBN 095902301

4) IAEA 1981 Shallow Ground Disposal of Radioactive
Wastes - Safety handbook.
Series No. 53.