SESSION SUMMARY REPORT

Session No.: 3A
Session Title: Disposal of Disused Sealed Radioactive Sources
Session Chair: Shirley Oue, Canada; Norasalwa Zakaria, Malaysia

SPEAKERS: E.T. Glover, Ghana; R. Little, United Kingdom; L. Aguiar, Brazil

Summary:

The growing inventory of disused sealed radioactive sources (DSRS) has brought on the need to discuss on the disposal of these disused sources. One disposal method for the DSRS is in a borehole disposal facility.

The borehole disposal concept (BDC) was originally proposed in 1995 for the disposal of Radium-226 needles. The original concept was later refined to include other radionuclides, technical barriers, and different geospheres and biospheres. However, the BDC has not yet been implemented.

The IAEA took up BDC as it may be a solution for many countries with no (or a small) nuclear power programme to dispose the long lived radioactive waste in geological formations without a geological disposal facility. The Generic Post-Closure Safety Assessment (GSA) software tool developed with support of the IAEA can be used by the respective countries to develop their national programmes.

The borehole disposal concept and the associated safety assessments have been undertaken to demonstrate that it can be a safe, long term management option for DSRS.

A series of iterative, peer-reviewed, generic post-closure safety assessments have been undertaken over the last 15-20 years to build confidence in BDC as a safe, long term management option for DSRS.

Country specific post-closure safety assessments were carried out by a number of countries. As a result of such efforts, some of these countries are about to apply for a license to construct, operate and close a borehole disposal facility.

Work is being conducted on a borehole disposal facility for long lived DSRS, following proposals provided by the IAEA. A site was selected and characterised by seismic reflection, electrical resistivity measurements and ground water analysis. Two 150 m deep boreholes were drilled at the site. The waste disposal zone lies in a hard rock formation and is located in a reducing geochemical environment. A post-closure safety assessment was carried out using IAEA recommendations. It was assumed that radionuclides are migrating with the groundwater flow to a water abstraction borehole. Screening calculations for a number of relevant radionuclides were carried out showing that the plume will arrive at about 70,000 years after disposal, and that the peak dose from all the radionuclides will be $1.97 \times 10^{-15}$ Sv/a.

In another example, one country has accumulated a large number (~190,000) of DSRS with a significant radionuclide inventory ($9.8 \times 10^{14}$ Bq). These sources are stored and it is planned to dispose...
them in a borehole disposal facility. This was a decision taken in connection with a Technical Co-
operation Project with the IAEA in 2014-2015.

In a preliminary safety assessment, it was shown that the calculated dose rate was below the limits
when Am-241 sources were excluded from the radionuclide inventory. National regulations provide
requirements for the licensing process for the disposal of short lived LILW only. The respective
requirements for long lived LILW still need to be addressed.

The borehole disposal concept for DSDR may also be attractive for countries with nuclear power
plants as it is assumed that a borehole disposal facility can be built faster than a geological disposal
facility. This would allow an earlier disposal of DSDR and a reduction of the storage period.

The depth of the borehole facility is a matter that needs to be properly addressed. The type of
radionuclides to be disposed of (short lived or long lived) and the associated time for confinement
have to be taken into account. However, the depth primarily depends on the geological/
hydrogeological situation at the selected site and the expected future site development.

Operational aspects have also to be taken into account and properly be resolved. This includes the safe
lowering of the waste packages containing DSRS into a borehole, the management of waste packages
that got wedged before they were completely lowered down or an unexpected drop of a waste package
into the borehole, as well as any retrieval of the DSRS from the closed facility should it be necessary.
In the latter case, over-coring is regarded as being a feasible and most suitable method.

While work on safety assessments of BDC has been conducted to demonstrate that it can be a safe,
long term management option for DSRS, further work may be needed before it is implemented, such
as:

- Safety assessment methodology and model emphasizing on sensitivity analysis, formulation of
  scenario, calculation model, corrosion model etc.
- Regulatory and Licensing process, covering the independence of regulator and the justification
  for a national decision.
- Security such as physical protection, inadvertent human intrusion and source retrieval.
- Safety Case, particularly how optimization and the defence-in-depth principle is applied in
  BDC, operational safety procedures, limitation of the BDC concept, and environmental
  consideration.
- Future research concerning BDC such as involving the dimensions of the borehole (wider and
deeper borehole), etc.