Spent Sealed Radioactive Sources Conditioning Technology for the Disposal at the National Repository Baia-Bihor

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ABSTRACT

A spent sealed radioactive source(SRS) is a high integrity capsule which contains a small amount of concentrated radionuclide with an activity which ranges from a few MBq up to levels of hundreds TBq.

Presently, there are now many spent and unusable SRS in Romania, which have been used a long time in various industrial applications (smoke detectors, weld testing etc.).

Considering the activity of the Radioactive Waste Treatment Plant (STDR) at the Institute for Nuclear Research Pitesti regarding radioactive source collecting from various economic agents, several radioactive sources are held in the intermediate storage deposit facility on the institute platform awaiting conditioning for the final disposal.

This paper presents the conditioning technology for this sources, which has as ultimate purpose to completion of a product which matches the waste acceptance requirements imposed by the National Authority Control of Nuclear Activities, CNCAN, for the disposal site DNDR Băița – Bihor.

The technology used for obtaining the final product allows two options for the immobilization of the sources in the 218 L steel drum and these are:

Sources placed in the original packages and which can not be dismantled will be isolated by encapsulation in 10 litters metal capsules and then conditioned in 218 l steel drum, with a concrete biological shielding;

Sources removed from the initial package are isolated in stainless steel capsules, which are to be conditioned in the same 218 L steel drum.

The final product obtained as a result of the concrete conditioning operations of the spent SRS in 218 L steel drum is the “steel drum – concrete – low radioactive waste assembly” which presents itself as a concrete block which includes one or more capsules containing SRS.

1 INTRODUCTION

Romania has been using sealed radiation sources for many decades in various areas of national economy, medicine and various research fields, their number being estimated to be very large and may have high concentration of radionuclides alpha, beta or gamma in extremely small volume.

According to Romanian regulations, the transfer of sources for treatment, conditioning and long term storage or disposal is performed without transfer authorization. In this case, the
sources are transferred to the Radioactive Waste Treatment Plant of the Institute for Nuclear Research Pitesti.

Before detailed planning conditioning methods is necessary to have all relevant facts about spent sealed radioactive sources, a complete assessment of the possible risk and an analysis of contamination and activity levels being within the limits given in the National Transport Regulations[1] and authorization of the Repository Baita – Bihor.

2 METHOD OF CONDITIONING OF SEALED RADIATION SOURCES

For the selection of the conditioning method, each source will be identified for its physical and chemical characteristics. Conditioning of spent sealed radioactive sources will include stages for disassembly and encapsulation in 10 L stainless steel capsules (Fig.1) and emplacement of the capsule in the center of a 218 L drum with concrete lining.

The operations for disassemble of containers for transport and storage of SRS and immobilization of sources in stainless steel capsules are done inside hot cells at the Post Irradiation Examination Laboratory (LEPI) [2]. Sources are placed in these prefabricated stainless steel capsules and encapsulate using the tack weld.

This laboratory is equipped with facilities that permit all necessary operations for encapsulation of the SRS.

Then, the capsules with sources (Fig. 1) are transferred at the Radwaste Treatment Plant (STDR) and placed in a concrete lined drum (Fig. 2) and undergo final conditioning by using cement.

The concrete is used for physical protection and security of the sources and the dose rate will be less than 2 mSv/h at the outer surface of the completed package.

Figure1: The capsule for location of the source
The conditioning procedure and the testing of the type A package for disposal was elaborated by the Radioactive Waste Treatment Plant of the Institute for Nuclear Research Pitești.

At the end of the conditioning process, the product obtained was tested in correspondence with Standard number 012 / 1994 [3], by the Reliability and Testing Laboratory of the Institute for Nuclear Research. The test conditions for final disposal include: impact, puncture, free drop test and penetration.

The product obtained is kept in interim storage at the storage facility, until it will be transported to the National Repository Baita-Bihor for disposal.

3 RESULTS AND DISCUSSIONS

The technology adopted covers all aspects involved in the management of the spent sealed radioactive sources for disposal.

The final product, after conditioning, is the assembly made up of metallic drum-concrete-radioactive wastes (ABBD-1), type A package, which will be disposed at the National Repository Baita, Bihor.

The waste form and package are determined by the acceptance criteria that include security tests and physical protection that are established by the competent authority, in our case the Romanian National Commission for Nuclear Activities Control (CNCAN) for the final disposal in the National Repository Baita, Bihor.

The final product that is obtained by this technology is presented in Figure 3.
Figure 3: Preparation of the drum for the final disposal

Where:
1. Steel drum;
2. Cavity inside in the cement matrix;
3. Cement matrix for additional shielding material required to meet dose rate criteria on waste package;
4. Encapsulation of SRS in stainless steel capsule;
5. Cement matrix for immobilization of the capsule;
6. Cement matrix for the cover of the drum;
7. Cover for the latch of the drum.

There are various amounts of radioactive waste that can be deposited in one steel drum, depending on the character of the given radionuclide and send to the Repository Baita-Bihor. A survey of these limits is given in Table 1.

Table 1: Limits of activity per one 218 L drum

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Activity in a 218 L drum, in $Bq/m^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{14}C$</td>
<td>$1 \cdot 10^9$</td>
</tr>
<tr>
<td>$^3H$</td>
<td>$1.5 \cdot 10^{10}$</td>
</tr>
<tr>
<td>$^{60}Co$</td>
<td>$1 \cdot 10^{11}$</td>
</tr>
<tr>
<td>$^{90}Sr$</td>
<td>$5 \cdot 10^9$</td>
</tr>
<tr>
<td>$^{137}Cs$</td>
<td>$1 \cdot 10^9$</td>
</tr>
<tr>
<td>$^{241}Am$</td>
<td>$5 \cdot 10^{11}$</td>
</tr>
</tbody>
</table>
4 CONCLUSIONS

The target of this technology for conditioning of spent radioactive sealed sources is to minimize the arising of disused and spent radioactive sources and it is in accordance with national and international legislation for transportation and disposal of the radwaste and with the IAEA programme on spent SRS established in 1991 (GOV/INF/595) [4].

The process parameters which affect the quality of the final product are standardized and comply with the following acceptance criteria:
- each waste drum will contain only one type of waste;
- the maximum content of radionuclides contained (maximum admitted activity) will be in accordance with the criteria for final disposal at the repository Baita-Bihor;
- the contamination at the 218 L drum outer surface should not exceed 4 Bq/cm²;
- the surface exposure rate of steel drum must be less than 2mSv/h;
- the determined lixiviation rate must be of maximum $10^{-3}$ cm/day.

REFERENCES


