



XA0300157

IAEA-CN-90/28

MANAGEMENT OF DISUSED SEALED SOURCES FROM THE NUCLEAR INDUSTRY IN CHINA

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Abstract.

Since the founding of the nuclear industry in China, more than 8000 disused sealed sources accumulated of which more than 1800 are Radium sources. Most of these sources were produced during the period 1960-1980. The disused radioactive sources are temporarily stored in a user's interim store. A project to manage these disused sealed sources is under way which includes inventory investigation, inspection, collection, transportation and long-term storage.

1. Introduction

From the 1950s, with the development of nuclear industry in China, sealed sources were used in geological exploration, milling, nuclear fuel and research laboratories, etc. According to preliminary investigation, more than 8000 sources were used. Among them, more than 1800 are Radium sources. Now, they are disused and temporarily stored in 80 organizations in 23 provinces. It is urgent to deal with these disused sealed sources under safe management.

As of 1997, China has implemented a project to build a centralized storage facility, and to transport all disused sealed sources from the 80 organizations referred to above to the facility and manage them by one organization. The project will be finalized by 2004.

2. Inventory investigation

As the first step and the basis of the project, an inventory investigation was carried out and a database was established. According to the investigation, 80 organizations used sealed sources, more than 40 types of sealed sources and more than 8000 sealed sources were disused, including more than 1800 Ra-226 sources as well as other sources (Co-60, Cs-137, U, Fe-55, Sr-90/Y-90, Am-241, etc.). Their activities vary from 10^3 - 10^{13} Bq. The total activity is about 10^{18} Bq. They are packaged in lead containers, metal boxes, wood boxes, plastic boxes, etc. Due to long history and poor management, data of some sealed sources are missing. It became necessary to undertake a detailed inventory investigation which required a period of almost 3 years.

3. Inspection and repackaging

As a part of the project referred to above, owners of disused sealed sources should self-check their own inventory, packaging and identification numbering of their disused sealed sources, making sure that they meet the requirements of safe transport and long-term storage set by China, and should submit relevant data to the implementation organization. The data include type of radionuclide, activity and the date of assay, exact quantity in each container, dose rate and surface contamination of each container, etc. The implementation organization provided technical support. For some owners which do not have the capability to undertake the task, the implementation organization carried out the task for them. The implementation organization cross-checked all the data submitted by owners of disused sealed sources. After cross checking, disused sealed sources of the same kind of each owner, where possible, were put into one big lead container shown in Figure1. Several small containers were put into a metal box with a size of $450 \times 450 \times 280$ mm.



Fig.1 The lead container with 54 Co-60 sources

4. Collection and transportation

After cross checking, the implementation organization will collect the disused sealed sources from each owner and the ownership of disused sealed sources will transfer to the implementation organization. For convenience of transportation to the centralized storage facility by railway, about six owners in different regions are selected as transfer route road to railway. The implementation organization collects disused sealed sources from each owner and transports them to the respective selected organization using a specially-built truck and awaits railway transportation. The longest way is more than 3000 km. In this endeavor, the implementation organization takes advantage of its transport system set-up for spent fuel, including provisions for emergency response.

5. Construction of centralized storage facility

Construction of a centralized storage facility is a part of the project. The centralized storage facility is near to a repository for I/LLW belonging to the implementation. The building size is 526m². The capacity is 200m³. The lifetime is 50 years. The disused sealed sources will be stored in a concrete structure with concrete covers, which is divided into dozens of small compartments. The concrete structure is of waterproof design. The facility is equipped with a lifting system, ventilation system, fire protection system, guard system against theft and monitoring instruments, etc.

6. Conditioning

Radium sources were used in geological exploration and milling. With the development of science, radium sources are no longer used. The disused sealed sources were produced in the 1950s and 1960s. It is necessary that these disused sealed sources be conditioned for long-term safe storage.

In 1998, China attended the demonstration project “INT14/131” sponsored by the IAEA. In June 1999, with the instruction of experts from the IAEA, 177 radium sources were successfully conditioned using latest conditioning techniques. The activity of the radium sources varies from 10³ to 10⁷ Bq. The total activity is 4×10⁹ Bq. 177 radium sources were sealed in 84 small stainless cylinder containers which are placed in one lead container. The containers of radium resources before and after conditioning are shown in Figure2. For conditioning the rest of the sources, the same method will used. For liquid disused sealed sources, a mobile solidification device was developed. Cementation with additives was applied. Liquid disused sealed sources were cemented *in situ*.

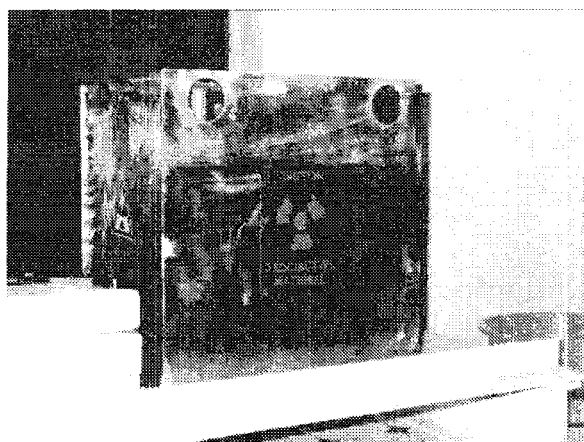


Fig. 2 Conditioned Ra resources

7. Long-term storage

The disused sealed sources will be stored in the centralized facility. They will be divided into several groups according to type of radionuclide and activity. Groups of disused sealed

sources of the same kind will be stored in the same area of the concrete structure. Managerial and technical measures will be taken to assure the safety. Trained and qualified staff will operate the facility. Routine monitoring will be carried out. The disused sealed sources will be kept in good condition during storage, waiting for disposal.

8. Conclusion

After the complete implementation of the project, the disused sealed radioactive sources scattered in about 80 organizations will have been safely managed. It is recognized that the project is conducive to public and the environment. The development of regulations for disposal in near-surface repository is under planning. Some of the disused sealed sources will be disposed of in near-surface repository. However, because of unavailability of a deep geologic disposal facility, these disused sealed sources will be stored for a long time.