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Conditioning of Spent Sealed Sources in Singapore

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1. Introduction

In 2010, IAEA (International Atomic Energy Agency) requested KAERI (Korea Atomic Energy Research Institute) to support Singapore for conditioning spent sealed sources. Once had been used for lightning conductor, check source or smoke detector, various sealed sources were collected and temporarily have been stored at HSA (Health Science Authority) under control of NEA (National Environment Agency) in Singapore. Based on experiences for conditioning of Ra-226 sources in various Asian countries since 2000, KAERI sent an expert team of three members to Singapore for safe management of spent sealed sources in 2011.

As a result of conditioning operation, about 575.21 mCi of sealed sources were safely conditioned in 3 cement packages with cooperation of KAERI expert team, IAEA supervisor, NEA staffs and local labors.

In this paper, procedure and result of the conditioning operation for the spent sealed sources in Singapore are discussed.

2. Preparation

Before the conditioning operation, source segregation plan, conditioning procedure, working area and materials were prepared and reviewed.

2.1 Source Segregation Plan

The segregation plan was developed based on radionuclides, type and radioactivity of the target sources. Table I describes the initial information on the sources given by NEA of Singapore which was in charge of management of the sources. In addition to that, twelve Ra-226 sources were added for the conditioning during operation.

For the conditioning, the sources should be segregated into stainless steel capsules and welded. After that, the capsules were packed in lead shields for final conditioning in cement lining drums. So, the segregation plan was set up as grouping the sources for the each capsule and grouping the capsules for each lead shield. As there were so many sources with various shapes, 2 types of lead shield were considered. Type I had 1 large hole (with inner diameter of 60 mm) at center and 5 small holes (with inner diameter of 50 mm) around the large one. On the other hand, Type II had 1 large hole (with inner diameter of 50 mm) at center and 6 small holes (with inner diameter of 40 mm) around the large one.

As each source has no ID, the major segregation plan was 1) grouping sources according to radionuclides 2) putting considerable amount of sources into one capsule 3) high activity sources at center hole.

Table I : Information on target sources

Source	Type	Shape	Qty.	Activity (mCi)
Am-241	lightning conductor, check source, smoke detector	steel plate, round ceramic piece, button	553	377.58
Ra-226	lightning conductor, check source	steel plate, button	2,583	193.53
Co-60	check source	button	34	0.17
Sr-90	check source	button	32	0.16
Total			3,202	571.43

2.2 Equipment and Material

2.1.1. Material for source packaging

For source packaging, stainless steel capsules for sources, lead shields for containing the capsules and concrete lining drums for containing the lead shields were required. On each lead shields and concrete lining drum, a name plate was needed for identification. In addition to that, steel bars, steel plates and concrete material for preparation of concrete drums, tongs for handling the capsules, tweezers, funnels, mirrors, trays and etc. for source handling during source segregation and transfer were required.

2.2.2. Material for welding

Welding was required for the capsules, lead shields and steel plates of the drums. For welding, TIG welding equipment, Argon gas, masks, and respirator were basically required. Additionally, a turn table and lead shielded pot were used for easy and safe operation. Also, for checking integrity of welding, leakage of the capsule was tested and some equipment such as compressor, desiccators, ethylene glycol, and etc. were used.

2.2.3. Equipment for radiation protection

For radiation monitoring of working area, dose rate monitor and surface contamination monitor were used. Also, for radiation protection of workers, TLD, pocket dosimeter, radiation mark, lead glass, lead bricks, area isolation tape, gas-faces masks with a filter for radon, overalls and etc. were required. In addition to that, materials for decontamination were also prepared at the conditioning area.

2.2.4. Miscellaneous materials

For safe and easy conditioning operation, light source, absorbent paper, concrete mixer, concrete vibrator, concrete mould frame, concrete drill bit and etc. were used.

3. Conditioning operation

Conditioning of spent sealed source was carried out at a designated area with working table and air exhausting unit.

3.1 Working area

As shown in Fig. 1, for efficient and safe conditioning operation, the working area was divided into transfer zone, receiving zone, welding zone, leak testing zone and material preparation zone. Before the operation, all the area was covered with vinyl sheet to limit contacting with radioactive dust. Also, radiation level of the area was checked for detecting contamination after the operation.

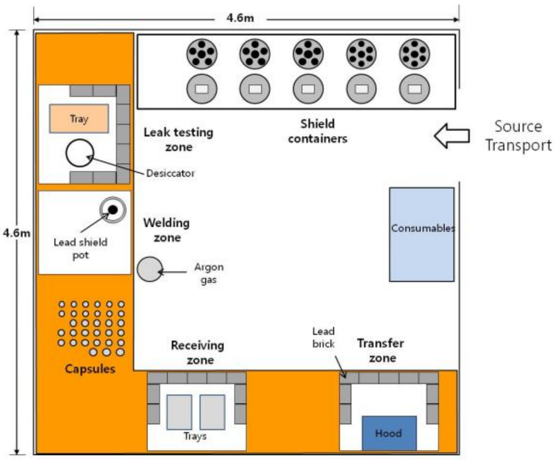

Fig. 1. Layout of the conditioning area

3.2 Procedure of conditioning operation

For the operation, a lead container with selaed sources was tansported to the conditioning area. At the entrance of the conitioning area, only sources were carried into the area. At the receiving zone, sources were segregated and some sources for 1 capsules were sent to the transfer zone. Once source packaging was completed, the capsule was sent to the welding zone with its lid covered and welded. After checking welding integrity, the capsule was inserted into a hole at the shield container. When all holes of the shield container were filled with the capsules, it was welded and packaged into a concrete lining drum. Finally, the concrete lining drum with 2 shield containers were combined with steel plate and stored at a radioactive waste storage room. Fig. 2 shows the lead shield with capsules and concrete lining drum with steel plate welded.

Fig. 2. Lead shield and concrete lining drum

4. Conclusions

As a result of operation in Singapore, totally 575.21 mCi of Ra-226, Co-60, Sr-90 and Am-241 sources were conditioned in 5 lead shields. And during operation, some secondary wastes were generated. All the lead shields were packaged into concrete lining drums. Because 1 drum could take 2 lead shields, 3 concrete lining drums were generated. (The last drum contained 1 lead shield with packaged secondary waste).

After the operation, each zone was decontaminated and radiation level of whole area was monitored but any contamination was not detected. Also, dosimeter reading shows that there were no over dose to the workers.

Finally, it is concluded that the conditioning operation of the spent sealed sources in Singapore was successful. But, as there were no ID on the sources and so many sources were conditioned with limited resources, accurate quantity or activity of sources for each capsule or lead shield was not check and only could be estimated based on the segregation plan. For better conditioning operation, pre-mission on-site for checking status of the spent sources may be necessary to the expert team.

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