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CONDITIONING OF LOW LEVEL RADIOACTIVE WASTES, SPENT RADIATION SOURCES AND THEIR TRANSPORT AT THE INTERIM STORAGE BUILDING OF THE INSTITUTE OF NUCLEAR PHYSICS IN ALBANIA

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Abstract

Aspects of treatment and management of radioactive wastes resulting from the use of radiation sources and radioisotopes in research, medicine and industry, are described. The methods applied for the conditioning of low-level radioactive wastes and spent radiation sources are simple. Solid radioactive wastes with low-level activity, after accumulation, minimization, segregation and measurement, are burned or compressed in a simple compactor of the PGS type. Spent radiation sources are placed into 200 l drums, are cemented and conditioned. Conditioned drums from the Radiation Protection Division of the Institute of Nuclear Physics (INP), which is the responsible Institution for the treatment and management of radioactive wastes in Albania , are transported to the interim storage building of the Institute of Nuclear Physics in Tirana. Work to construct a new building for treatment and management of radioactive wastes and spent radiation sources within the territory of INP is underway. Funds have been allocated accordingly: based on the Law No. 8025 of 25.11.1995, it is the Albanian Government's responsibility to finance activities concerned with the treatment and management of radioactive wastes generating from the use of ionizing radiation in science, medicine and industry in the country.

1. INTRODUCTION

The main users of radioisotopes in Albania are the Academy of Sciences (Institute of Nuclear Physics) and the University Hospital Center "Mother Theresa" (Nuclear Medicine Laboratory and Oncology Institute) in Tirana. The majority of these sources are used for calibration, scientific research, brachytherapy and teletherapy, and different organ functioning tests of patients. Radiation sources are also used in industry (well logging, thickness meters, level gauges etc.). The main radioisotopes in radioactive wastes in Albania are: 99 ' Tc; ^{131} I ; ^{125} I; ^{32} P; ^{51} Cr; ^{65} Zn; ^{60} Co ; ^{137} CS. ^{192} Ir ; ^{242} Am ; ^{238} Pu ; etc, which make up more than 95% of all the volume of solid radioactive wastes generated by nuclear units in Albania. The annual quantity of solid radioactive wastes generated by research institutions and nuclear research units in operation is 1 Ci / m^3 [1]. After the solid radioactive wastes have been immobilized , the waste packages are normally placed in an uncontaminated area , where the final control is carried out for a period of several days. The usual types of solid radioactive wastes are plastic tubes , papers , gloves, clothes , PVC materials , laboratory glassware, emptied containers and some secondary wastes produced during treatment of liquids. Their origins are research laboratories, the radioisotope production department, and the radiobiology and radiopharmaceutical departments. Solid radioactive waste are received in plastic or nylon bags (packages) and sometimes in 200 l drums. Usually the solid radioactive waste with its package is fed directly into the drum and a compaction of the solid radioactive wastes is performed.

Compaction is a mechanical volume reduction technique used at INP for low level combustible solid radioactive wastes. A volume reduction factor of 0.4 - 3 is obtained, depending on the type and compressibility of the wastes [1]. The waste bags are grouped together according to their specifications. The nuclides , their half lives and the volume of the bag are evaluated. If

there is enough space on the drum to keep the bag until the activity decreases to exemption level within 1-3 years, it is better to keep it in the storage room for decay. Drums can be transported after at least 3 days stay at the facility building. A layer of up to 5 cm of cement has to be added, whenever possible, before the drum is transported to the interim storage buildings.

The interim storage period can take many years. Interim storage provides for an observation period of some years before disposal of the drums in the repository. During that time, drums are periodically controlled for deformation, corrosion, etc. since necessary precautions must be taken before disposal. Interim storage can take advantage of the activity decay with time to facilitate the safe transport to the repository. If the activity will decrease to exemption levels within 10 or 15 years, interim storage is used for that kind of conditioned wastes as a temporary host until they are sent to municipal waste collection area [2].

2. MATERIAL AND METHODS

The preferred option to reduce the safety risks for accidents with spent radiation sources is the conditioning or immobilisation of spent sealed sources in a matrix, as soon as they are verified as spent radiation sources. The method has the advantage of using unsophisticated technology and material and equipment which are easily available. The product package (200 l drum) is stable for a long time under interim storage conditions. Using an additional shielding inside the drum it is always possible to reduce the surface dose rate. By proper conditioning of a spent sealed source in concrete, the source is transformed into a form which cannot cause any large exposure even if the waste package is handled without special precautions [3,4].

3. RECEIVING THE SPENT SOURCE

As soon as the source container or equipment is received, the surface dose rate is measured and an identification number is given. A registry form [Registration Form No. 1] was opened for each received spent sealed source. As is shown on this registration form, e.g. for a cesium source (Cs- 137) bought by INP, all data are taken from the official passport of the Institute of Isotopes Co. Ltd. Budapest. All fields in the form No. I are filled in with the data obtained from the official passport or from the radioactive source label. If data are vague or no data available (nuclide, original activity, production date), verification of data is carried out.

Registration Form No. 1

Received Sealed Source	
Ident. No: 040- 4 M	Surface dose rate 1.1 mR/h
Received date: January 1996	Notified Nuclide Cs-137
Origin: Elbasan Steel Factory	**Original** Activity 0.09 Ci
Weight of Cont. 60 Kg	Production date: 1978
Resp. Person: Unknown	**Producer** Institute of Isotopes, Hungary
Verification:	Dose rate at I in 28 μR/h
Date: 27.05.1996	Leakage: No, sweep test by cotton
Nuclide & Activity: Cs-137, 0.088 Ci	Responsible Person: Luan Qafinolla
Note:Surface dose rate has been verified	

4. CANDIDATE SOURCE FOR CONDITIONING

Sometimes, the activity of an individual source may be very large so that conditioning and additional drum shielding can not decrease the surface dose rate enough for it to be transported. In Albania , in accordance with IAEA recommendations, conditioning of spent radiation sources in Type A and Type B packages was used. The conditioning option is based on the immobilization. of the source within a Type A package. The source in its cask and container is placed in the center of a 200 l drum filled with cement mortar. This conditioning procedure is suitable for any type of source, assuming its size (including casket and container) allows it to be conveniently accommodated in the center of a 200 l drum. Conditioning in this way prevents unauthorized removal of the source because of the weight, bulk and robust nature of the package. It also provides a barrier against loss of containment of radioactive material. The adoption of this method will depend upon a number of factors including:

- the number of spent sealed sources
- the half life and activity of the sources
- the toxicity of the radionuclides in the sources
- the final disposal scheme for the sources.

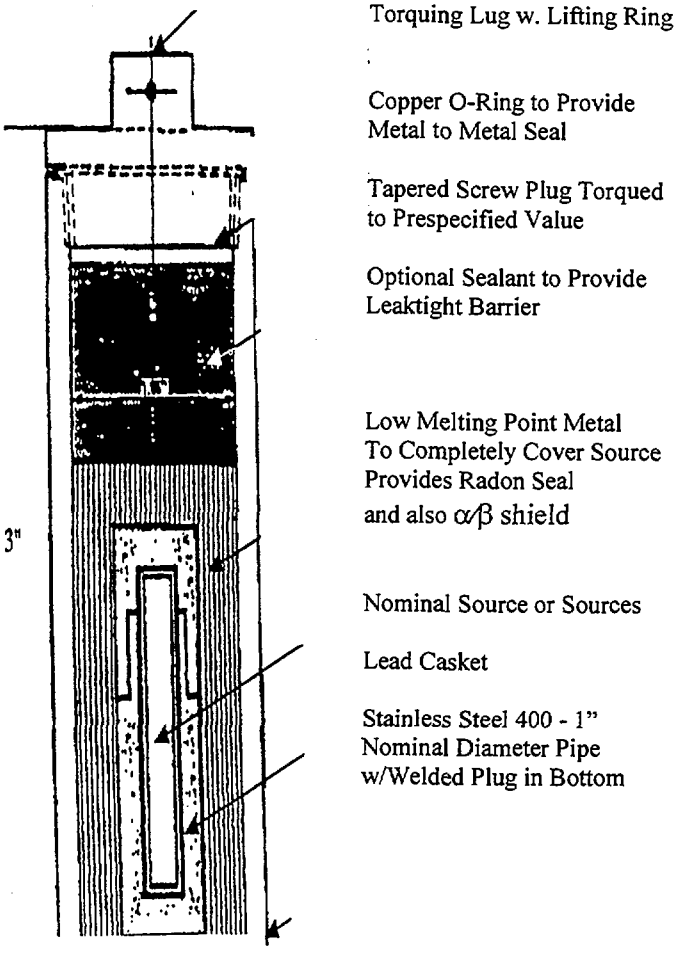
INP has used conditioning in Type A packages as an attractive option having a small number of spent sources and wishing to provide additional security and containment. Examples and types of spent solid sources which normally are conditioned in INP (see Form No. I sheet) in 200 l drums are industrial gauges and industrial radiography sources [2,5,6]. There are 10 - 20 of this kind of sources, mainly ^{137} Cs and ^{60} Co sources. The Institute of Nuclear Physics has planed to receive, during 1999, some tens spent radiation sources from industrial plants in Elbasan, Fier , and Shkodra for conditioning.

Conditioning in a Type B package is shown in Figure 1. This package is used to condition a spent radiation source of the Oncology Institute in Tirana (900 Ci cobalt teletherapy head). In this case a special waste package (prefabricated cube and stainless steel) has been prepared to condition this spent solid source. This comprises a pipe with a plug welded to the bottom. The bottom is fitted with a source holder and the top has a tapered stainless steel screw plug which is sealed to the pipe with a copper 0 - ring. This provides a tight metal to metal seal. If the surface dose on the package exceeds 2 mSv/h it can be encapsulated in a cement matrix using a 200 l steel drum. Calculation of the surface dose rate of waste package is necessary for a number of reasons: to prove that the waste package, after cementation, will have an adequate dose rate on its surface - in some cases, additional lead sheet shielding may be required around the source shield; .to provide for as many sources of one type as possible to be put into one drum. Besides physical volume restrictions, the dose rate calculation may necessitate to put a limited number of sources

A registration form [Registration Form No.2] was opened in INP for each cemented waste drum and all available data of conditioned waste drums. The number of the drum, kind of spent solid source and some data of the conditioned sources are registered in the inventory register of the SSSR programme on a Personal Computer.

The old storage building, constructed in 1970 on INP territory, was a simple hall on the ground surface (concrete and brick construction). The old storage building is actually out of use because, after the political changes, people moved into the unused area and built houses there without permission. The old building is now surrounded by private houses, the nearest of which at a distance of 10 m. For that reason, the Institute has transferred all the bags and drums into another temporary storage facility at INP. This building has been built above ground water level and can not be reached by a potential flood or ground water. It has 12 underground channels and the outer dimensions of the building are 6 x 3 x 2 m. Two layers of drums can be stacked one on the top of another (diameter 60 cm, height 88 cm) for standard 200 l drums [5,6].

Figure 1: Conditioned Spent Sealed Source in a Type B package.



Registration Form No. 2

Cemented Waste Drum			
Drum No.	3	Cement used:	50 kg.
Date:	28.5.1996		
Waste type &	Spent Sealed Source		
Amount:	3 sources.		
Nuclide	Activity Total Activity		
Cs-137	0.09 Ci	Mix time:	1 hour
Cs-137	0.26 Ci	Weight:	>550 kg
Cs-137	5.20 Ci	Surface dose rat:	1 mR/h
	5.55 Ci	Dose rate at 1 m.	60 μR/h
		Surface contamination:	No.
Drum Quality:	Inside surface painted	Respon.. Person:	Luan Qafmolla

Conditioned drums are loaded, by the Radiation Protection Division of INP, on the truck with a fork lift. There is about 500 m distance between the treatment facility and the interim storage building [7]. Drums have to be stacked in such a way that their numbers are clearly seen from the outside of the stack. The new interim storage building is constructed this year in an uninhabited part of the territory of the institute and radiation signs alert any person who may approach the building. The dimensions of this building are 17 x 16 x 4 m. Three layers of standard 200 l drums can be stacked.

Based on the Law No. 8025 of 25.11.1995, it is the Albanian Government's responsibility to finance the activities concerned with the treatment and management of radioactive wastes generating from the users of ionizing radiation sources in the scientific research, and in medical and industrial applications [8]. A fund of 70.000 USD was allocated by the Albanian Government in order to "establish the Radioactive Wastes Facility for the Management of Spent Sealed Sources and Hazard Materials ". Construction has already been started of the new Radiation Waste Facility within the territory of INP, where all the radioactive wastes and spent radiation sources generated by the nuclear units of Albania will be conditioned. It is planned to store about 300 drums to give enough space for movements of truck and lift fork. It is expected that the capacity of this new building will be fully sufficient up to the year 2050.

5. CONCLUSION

Funds have been allocated by the Albanian Government to construct a new Radioactive Waste Facility and to support the programmes and activities on radioactive waste management in Albania which are carried out within the frame of an IAEA Project on "Strengthening of Radiation Protection and Radioactive Waste Management Infrastructure". As a next step, all nuclear units operating in Albania, with their financial contributions, will maintain all the activities related to the management of radioactive wastes, establishing a national institution which will be responsible for all aspects concerning the management of dangerous materials. Methods used by INP up to now, to condition low-level radioactive wastes and spent radiation sources, are performed in compliance with the experience of other countries, IAEA recommendations and world -wide literature. Some State Institutions such as the Ministry of Health, the Radiation Protection Commission, and the Institute of Nuclear Physics, which are responsible in the field of management of radioactive wastes, will continue on the investigation and establishment of a new national policy in this field.

References

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