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THE RIGHT MANAGEMENT STEPS FOR RADIOACTIVE WASTE IN KOSOVO

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Abstract

In this paper is described the present situation in Kosovo concerning the radioactive waste management and namely the waste inventory, classification, interim storage and final disposal considering IAEA documents on this topics. There are more than 100 sealed radioactive sources out of use, including radioactive lightning, other than radioactive waste generated in nuclear medicine departments of hospitals. As result of the necessary information lack for most radioactive sources, were used different methods to identify the type of radionuclide and its activity. Using the IAEA waste classification scheme is carried out the determination of the appropriate methods for safe management of the different group of waste, including its interim storage and final disposal.

Keywords: *radioactive waste inventory, waste classification, waste management.*

Introduction

The issue of the safe radioactive waste management is related with public exposure for present and future generations all over the world. To avoid this unnecessary burden of exposure, International Atomic Energy Agency (IAEA) has published the main principles of the radioactive waste safe management as well other important documents concerning safety principles [9]. Nevertheless as result of improper radioactive waste management, a public concern exists related with its entering in the human biological cycle and the potential risk of public exposure. For this purpose a series of measures are recommended to provide high safety and security for management of radioactive waste, aiming its confinement and isolation from the biosphere. Recent years IAEA published a new scheme for the classification of the radioactive waste [7], which intends to perform not only a new classification scheme of the radioactive waste, but in the same time to recommend its safe management for interim storage or final disposal.

Materials and Methods

Kosovo has a number of radioactive substances but among the most common are those which we have shown in this map that contains the names of cities and companies or factories. Methods used in this research are mainly working methods from the scene or better say reporting methods as a result of our work directly in the process of identifying and handling hazardous substances. The overwhelming majority of resources or information of this paper are resources on the basis of scientific research methodology of call as primary sources. Regarding the specific gamma constant values (Γ), they are taken from references (Unger and Trubey,

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1982), where besides the specific gamma constant for various radioactive sources was given the radioisotope half-life period and the respective energy values of gamma radiation issued by this radioisotope. As measuring devices is used an instrument for measuring of dose equivalent rate, which besides value of equivalent dose rate have identified the type of radioisotope. This measuring device is: "Exploranium GR-130", which is owned by the Protection Service Radiation Institute of Occupational Medicine, Obilic [1]. Based on these measurements is powered Table 1, in which the key data are presented for each source of radiation, including the type of radioisotope, half-life period, specific gamma constant and activity of radiation sources. In this study were presented the results of determining the activity of various radioactive sources that were located in different institutions, was used relation that exists between a radioactive source and equivalent dose rate that creates the radioactive source at a certain distance. Relation between the magnificence given by the following expression [3]:

$$H' = \Gamma\ a / r^2 \tag{1}$$

Where *H'* is the dose equivalent rate in mSv / h , *Γ* is the specific gamma constant of radioactive sources $mSv.m^2/MBq.h$, *a* radioactive source activity and *r* is distance measuring device from the radioactive source. Starting from the above link can be drawn activity of a radioactive source *a*, a (power) function of dose equivalent rate *H'* and *r* the distance measuring apparatus of the radioactive source in the study.

$$a = H'.\ r^2/.\Gamma \tag{2}$$

For this purpose in each case was carried out by our measurement of dose equivalent rate of a given radioactive source in a fixed distance, which for ease of calculation is taken equal to 1 meter. Theoretically it is known that the Co-60 radioisotope has a decay scheme where first occurs beta emission, and as result created the Ni-60 nucleus in the excited state, which passes in stable condition, releasing two gamma rays with energy 1170 keV and 1330 keV and halving period 5.27 years [2].

Table 1. Halving the period values, specific gamma constant, dose rate and activity for radioactive sources in the form of waste

Radioactive source, location	Period of halving	Specific gamma constant	Distance, the power of dose	Activity
Object A				
Source 1			1m,1.06 µSv/h	$0.4x10^3$ MBq
Cs-137	30.17 year	1.02E-04	2m,0.13 µSv/h	$0.2x10^3$ MBq
Source 2			1m,2.78 µSv/h	$1.19x10^3$ MBq
Cs-137	30.17 year	1.02E-04	2m,0.15 µSv/h	$0.25x10^3$ MBq
Source 3				
Cs-137	30.17 year	1.02E-04	1m,0.10 µSv/h	$0.04x10^3$ MBq
Source 4			1m,0.19 µSv/h	$0.08x10^3$ MBq
Cs-137	30.17 year	1.02E-04		
Source 5			1m,0.23 µSv/h	$0.09x10^3$ MBq
Cs-137	30.17 year	1.02E-04		
Object B				
Source 1	5.3 year	3.70E-01	1.5m,0.08 µ Sv/h	$0.01x10^3$MBq
Co-60				
Source 2	5.3 year	3.70E-01	1.5m ,0.09 µ Sv/h	$0.02x10^3$MBq
Co-60				
Source 3 C0-60	5.3 year	3.70E-01	1.5m ,4.13 µ Sv/h	$1.01x10^3$MBq

As measuring instrument were used “Exploranium GR-130” and “Inspector 100”, which gave the values of the equivalent dose rate and perform identification of the radionuclide. Concerning the radioactive waste generated by nuclear medicine, in collaboration with medical staff of the clinics were treated the waste from the use of molybdenum-technetium generators of “Gentec 2-120” type with initial activity of 6 GBq. In this generator is used radionuclide of Mo-99, which through decay gave radionuclide of Tc-99 m with half life 6 hours (T = 6 hours). Another radionuclide which is used by the clinics for therapeutic purposes is I-131 (T = 8.1 days). Both mentioned radionuclides are with very short half lives, and therefore the generated radioactive waste needs to store for relatively short interval of time [6]. Nevertheless it is an urgent need to inform the medical staff on the principal rules for safe management of the mentioned type of waste. Based in the five mentioned groups the classification scheme of radioactive waste in Kosovo is presented in Fig. 2 in accordance to the classification scheme of IEAE [7]. In this figure are represent seven classes of radioactive waste. The classes vi (Intermediary Level Waste – ILW)) and vii (High Level Waste – HLW)) are not exist in Kosovo and for this reason their representation in the figure is done by dashed line.

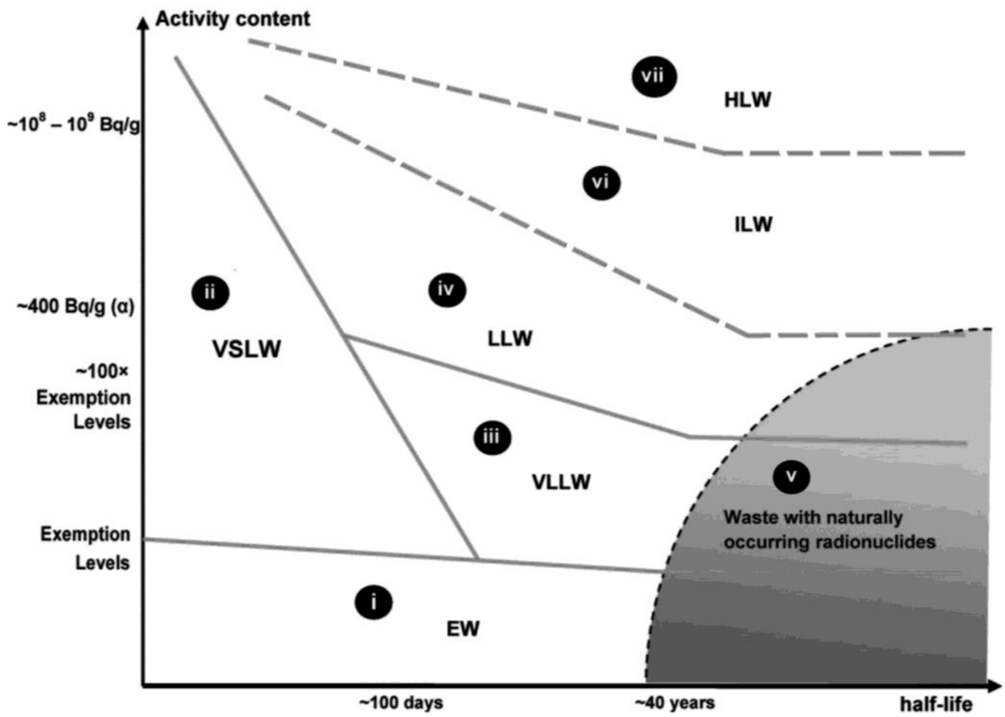

Fig. 1. Classification of radioactive waste in Kosovo

Fig. 1. represents: i) There are some radioactive sources like Co-57 or Co-60 with low initial activity, which as result of their half lives now have the activity below 0,1 MBq or 1 MBq (exempted activity for Co-57 and Co-60 respectively). These sources belong to EW; ii) The radioactive waste generated in nuclear medicine clinics (Tc-99m and I-131) with very short half lives consist VSLW; iii) The majority of radioactive waste in Kosovo are with very low activity and belongs to the third group of radioactive waste – VLLW; iv) There are some radioactive sources like Am-241, Pu-238, Th-228, radioactive lightning (Eu-152, Eu-154)

which are with long half lives or alpha emitters. The mentioned sources needed to treat with caution considering their confinement and isolation, which as general rule ought to resist for some hundred years. These sources belong to LLW; v) There are big quantities of industrial waste near to chemical or mineral complexes in Kosovo, which content natural occurring radioactive material (NORM) of different activities concentration. This waste as general rule contents low concentration of natural radionuclides, but it's their long half lives require special studies for considering its handling in different branches of economy or its management in accordance with its concentration. This group of radioactive waste belongs to NORM waste.

Results and Discussions

Based in the inventory of radioactive waste in Kosovo as well in its classification, it is with interest by practical needs to organize its safe management in accordance with IAEA recommendations. The safe management of radioactive waste is implemented in accordance with its pertaining in the mentioned different groups of the classification scheme. From safety point of view it is necessary to distinct the waste with radionuclides half lives shorter than 100 days, the waste with half lives less than 40 years and the waste with half lives more than hundred years. This is related with radioactive danger represented by different group of radioactive waste, which is proportional with its half lives. A high degree of safety can be provided through implementation of the institutional control measures, considering the safety and security of storage installation (e.g. landfills). The limitations of waste activity, which might be stored in a specific installation is related also with radiological, chemical and biological waste properties. Considering the radioactive waste group classification and its safe management in accordance with IAEA recommendation it is reasonably to propose as follows:

- Exempted waste (EW) which contents very low activities, did not need special conditions for radiation protection. This category of waste can be deposited in ordinary landfill or can discharged (for liquid waste) through urban sewer.
- Very short lived waste (VSLW) contents radionuclide, which ought to store just as its activity to decrease below the exempted one. Example of VSLW is waste of Tc-99m or I-131, which as rule are stored for ten half lives in a special place inside of medical clinics.
- Very low level waste (VLLW) is the majority of radioactive sources used in different gauges after their life. The safe management of this group requires to provide special radiation protection measures for time intervals of some decades. The storage of this waste needs simple surface installation.
- Low level waste (LLW) is the waste of Am-241, Cs-137, Th-228, which consist radionuclide with high half lives or emit alpha radiation. For such waste needed special confinement and isolation, which resist for some hundred years. The storage and final disposal for this group is related with more special installations [8].
- NORM waste after its control for the level of radioactivity can be used in different activity e.g. road construction layers, filler in cement industry etc.

Using the device "Exploranium GR-130" was performed gamma spectrometry analysis of radioactive sources, which has resulted in the building of their gamma spectra. Fig. 2 shows the spectrum of a source of cobalt-60 Co, which emits gamma radiation of the two groups energies: The first energy interval 1119-1208 keV and the second in the interval 1285-1370 keV.

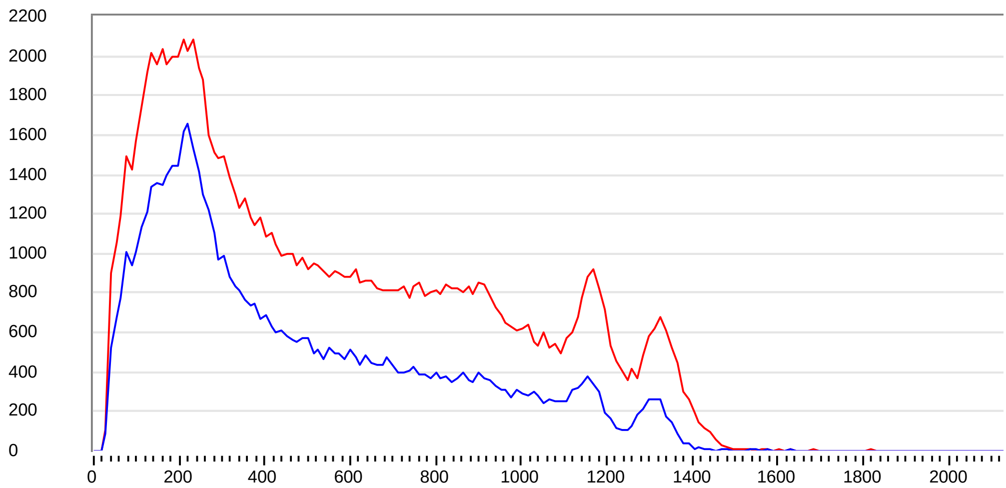

Fig. 2. Display gamma spectrometric two Co-60 sources

The first peak corresponds to the energy of 1170 keV gamma radiation, while the second peak belongs energy of 1330 keV gamma radiation. Energies corresponding to this decay scheme fit precisely the source of Co-60, which is part of the library industrial GR-130 device.

Conclusions

The presence of radioactive waste in Kosovo requires as urgent need to investigate in detail the situation and to propose a suitable long term solution. The study of radioactive waste has showed that more than 100 radioactive sources needs to collect and to manage in accordance with IAEA recommendations. Meantime exist a lack of information related with location and radionuclide identification as well. The present study is a first effort to put in evidence the issue related with safe management, its classification and the methods of its interim storage and disposal as well. For this purpose it is proposed to provide a full study of radioactive waste in the country and to invest for a centralized facility, which will provide the treatment and interim storage of radioactive waste in accordance with its classification group.

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