LEGAL FRAMEWORK AND MANAGEMENT OF SPENT SEALED RADIOACTIVE SOURCES IN ROMANIA

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ABSTRACT

According to national legislation in Romania, spent sealed radioactive sources (SSRS) are considered radioactive waste. Accounting, collection, storage, treatment, conditioning and disposal of SSRS are performed by the Radioactive Waste Treatment Plant (RWTP) as well as the National Repository for Radioactive Waste (NRRW) in the National Institute of Research & Development for Physics and Nuclear Engineering "Horia Hulubei" (NIPNE) from Bucharest.

Legislation specifies that the holder of authorisation have the obligation and responsibility to take all necessary measures in order to ensure and maintain a strict record of the nuclear and radioactive materials as well as of all sources used or produced.

A database of SSRS is kept by RWTP but it is incomplete, usually the missing data being the activity of sources. The loss of regulatory control on the SSRS is avoided since the license of manufacture, import, utilisation, transfer and transport of these sources are done according to a strict procedure of authorisation.

INTRODUCTION

As in many countries word-wide, sealed radioactive sources (SRS) are widely used in industry, medicine, environment monitoring and research in Romania. The national legislation in Romania specified that if no further need is foreseen for the SRS, then the spent sealed radioactive sources (SSRS) are considered radioactive waste. Accounting, collection, storage, treatment, conditioning and disposal of SSRS are performed by the Radioactive Waste Treatment Plant (RWTP) as well as the National Repository for Radioactive Waste (NRRW) in the National Institute of Research&Development for Physics and Nuclear Engineering "Horia Hulubei" (NIPNE) from Bucharest.

Users of sealed radioactive sources (SRS) purchase them from Romanian manufacturers or import them from other countries, although the import of SSRS is prohibited in Romania. There are two authorised SRS manufacturers in Romania:

- The Center for Production of Radioisotopes in the National Institute of Research&Development for Physics and Nuclear Engineering "Horia Hulubei" (NIPNE) from Bucharest;
- Post Irradiation Examination Laboratory in Autonomous Company for Nuclear Support Activities (RAAN) from Pitesti.

The first produce Co-60, Cs-137 and Ir-192 sources; while the second, which is a subsidiary for the Nuclear Research Pitesti, produce Cs-137, Co-60, Ir-192 sources. However, in the last two years both the Center for Production of Radioisotopes and Post Irradiation Examination Laboratory have produced only Co-60 and Ir-192 sealed sources.

LEGISLATIVE FRAMEWORK

The national competent authority in the nuclear field responsible for the regulation, authorisation and control of nuclear activities in Romania, is the National Commission for Nuclear Activities Control (NCNAC) (1). Authorisation issued by NCNAN is required for the manufacturing, utilization, import, export, transfer and transport of SRS.

According to the 2000 edition of the Fundamental Radiation Protection Norms, all new practices that will result in exposure to ionizing radiation shall to be justified in advance specifying their economic, social or other benefit in relation to the health detriment they may cause (2). The existing practices shall be reviewed as to whether new and important accounting about their efficiency or consequences is acquired. NCNAC can stop the development if the practices are not justified. The authorisation holder has to comply with the ALARA principle, in other words demonstrate that all exposures are kept as low as reasonable achievable, economic and social factors being taken into account.

The limit on effective dose for exposed workers is 20 mSv per year, although for some practices or radiation sources, NCNAC establishes dose constrains within context of optimization of radiological protection.

The following regulates the management and disposal of SSRS in Romania:

- Law 111/1996 on the safe deployment of nuclear activities, amended in 1998;
- Radiation Protection Fundamentals norms, 2000
- Republican Nuclear Safety Norms - Work Rules with Nuclear Radiation Sources, 1976;
- Republican Norms for Physical Protection of Nuclear Materials, 1976;
- Republican Nuclear Safety Norms for the transport of radioactive materials, 1976;

According to these legislation, the holder of the authorisation have the obligation and responsibility to take all necessary measures in order to ensure and maintain a strict record of the nuclear and radioactive materials as well as of all sources they use or produce. The authorisation issued by NCNAC contains information on the installation where sources with life greater than exempt limits are used. Details of each authorisation are held on the NCNAC database. The loss of regulatory control on the SSRS is avoided through a strict procedure of authorisation for the

license of manufacturing, import, utilisation, transfer and transport of these sources by. Figure 1 shows the flowchart of radioactive waste, SRS and SSRS in Romania.

Regulatory framework for the manufacture, import and use of SRS

The authorisation issued by NCNAC contains a chapter entitled "LIMITS- Sealed radioactive sources". In this chapter data on the radionuclide, activity, number of pieces, serial number, and serial number of container for each SRS are recorded. Each SRS manufacturer has to keep and maintain a strict record of SRS manufactured, supplied and stored.

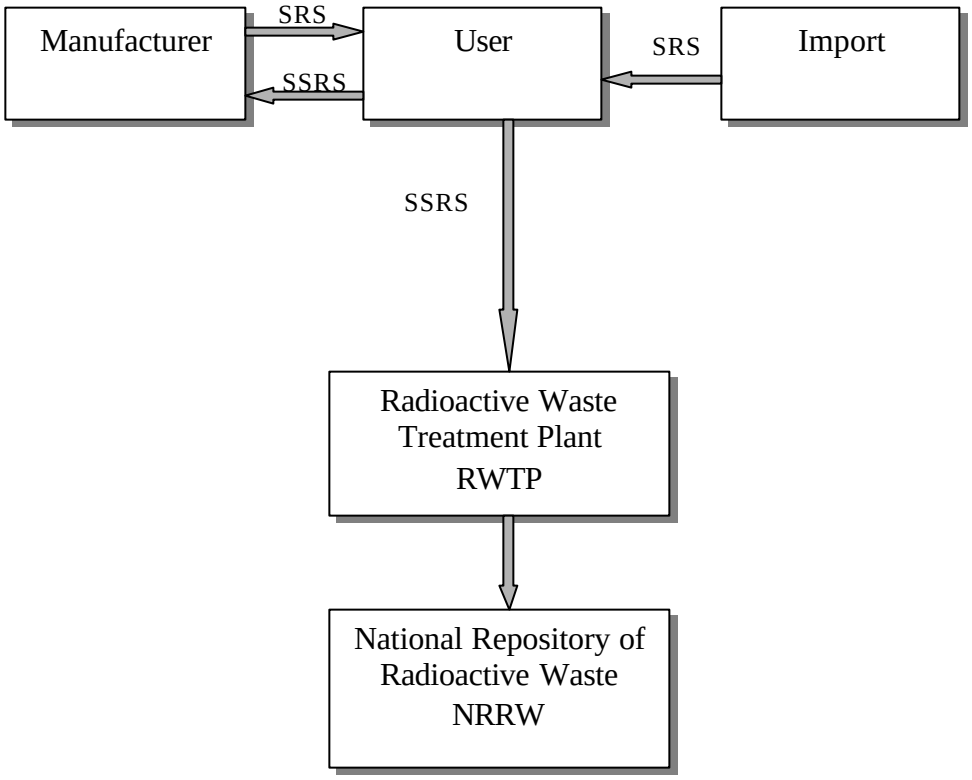


Fig. 1 Flowsheet of radioactive waste, SRS and SSRS

According the previsions of the chapter entitled "CONDITIONS" the holder of the authorisation has to provide NCNAC with an annual report on its activity including the transfer of SRS. Another condition is to send all SRSR back to RWTP or to return the source to the manufacturer. The Romanian manufacturer accepts the sources to recover the nuclear raw material. The most frequent cases include Co-60 and Ir-92 gammagraphy sources. To return the SSRS to the manufacturer is the user choice, and is not imposed on the user of the source by NCNAC.

Each holder of import authorisations must keep a record of radioactive materials imported, SRS, and nuclear installations. The importer reports to NCNAC on an annual basis, the number and type of SRS imported separately for each radionuclide.

In cases where a holder of import authorization is also the user of SRS, then the import is approved if the holder applies for a change of authorisation from NCNAC. The new authorisation contains data on all sources, including the new sources.

Regulatory framework for management of SSRS

According the previsions made in Law 111/1996 on the deployment of nuclear activity control and as amended 1998, the holder of authorisation shall compulsorily:

- be responsible for the management of his own radioactive waste activity;
- bear the expenses related to the collection, handling, transport, treatment, conditioning and storage and/or disposal of this waste;
- pay the legal contribution to the Fund for the management of radioactive waste and decommissioning.

Romanian legislation specifies that SRS is not considered SSRS even if they are not in use any more. A SRS become SSRS when the user sends it to RWTP for treatment, conditioning, storage or disposal.

The Radioactive Waste Treatment Plant maintains and develops a record of incoming radioactive waste, but SSRS are recorded separately. The content of the record includes: the user of SSRS or radioactive waste, radionuclide, activity and measurement time, serial number of SRS, serial number of container, place of storage, serial number of package for disposal. RWTP has to notify NCNAC for any irregularities, for example errors of authorization, absence of source serial number, absence of source, etc.

There is no national database of SRS but NCNAC efficiently regulates and control the movement of SRS from one user to another. A database of SSRS, although incomplete, is kept by RWTP, usually the missing data being the activity of sources. In the last two years RWTP has been developed an electronic radioactive waste database that contains a section for SSRS.

MANAGEMENT OF SPENT SEALD RADIOACTIVE SOURCES

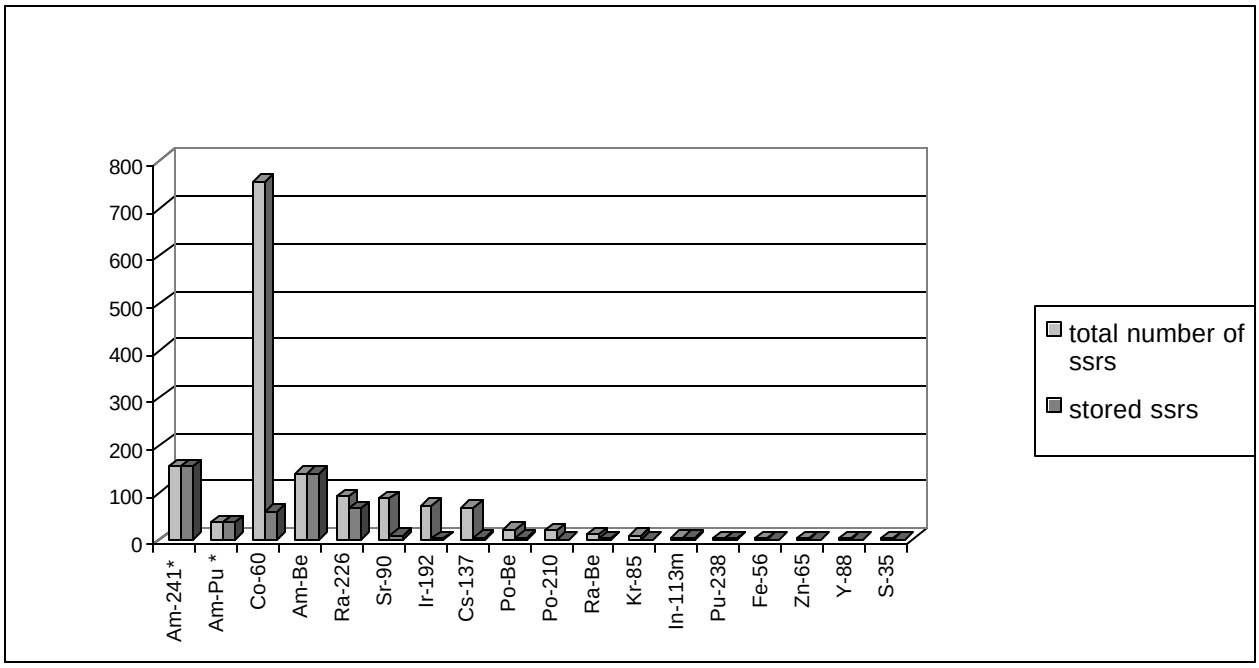
The development of nuclear techniques and the commissioning of the WWR-S research reactor belonging to NIPNE brought new problem to deal with in Romania, namely the storage and disposal of radioactive waste. NIPNE decided to store the radioactive waste inside the building that belonged to the defense of Capital City system (the Army) called Fort, which is located on the Magurele site. This building was used by NIPNE as a storage facility for radioactive waste and SSRS since the 1950's. The first attempt to decommission the Fort building was in 1975, which is the same year as the commissioning of RWTP. A large quantity of wooden radioactive waste stored on the rounding area was incinerated, while the radioactive waste and SSRS inside the Fort building were moved. When the around area was cleared all the windows and doors of Fort building were closed.

In 1977 the Fort building was broken into and a lot of containers, some of which containing SSRS, were spread on the surrounding area. After this event NIPNE decided to decommission

the Fort building and all radioactive waste and SSRS to be transferred to the RWTP. All operations and radioactive waste were recorded during this operation, but still a lot of data were lost. The decommissioning process resulted in about 1500 packages containing the radioactive waste and SSRS conditioned in cement. In addition, a lot of large containers, some of which containing SSRS were also generated.

Since the commission of NRRW, about 5500 packages containing radioactive waste and SSRS conditioned in cement have been disposed in NRRW. There are still about 800 packages containing cement conditioned radioactive waste and 100 SSRS in large containers in the storage facility of RWTP that need to be repackaged, because they are in an advanced degraded state.

RWTP has maintained a separate record of the radioactive waste and SSRS since it's commissioning. The records indicated that about 20500 SSRS are stored or have been disposed. These records include about 15,400 SSRS of Am-241 and 3,700 SSRS of Am-Pu from the decommissioning of fire detectors. About 2000 SSRS have been conditioned in cement and disposed at NRRW. Figure 2 shows the total number of SSRS and the SSRS in the storage facility at RWTP.



* - value is divided by 100

Fig. 2 Total number of SSRS and the SSRS in the storage facility at RWTP

Treatment, conditioning and storage of SSRS

The Radioactive Waste Treatment Plant is also responsible and includes facilities for the treatment of liquid, burnable solid, compacting and shredding of radioactive waste. Resulting products from these facilities are conditioned in cement in 200 liters standard packages. The

packages containing the cement conditioned radioactive waste have been prepared for transport and disposed at NRRW.

The storage facility of RWTP contains 5 rooms with drainage, ventilation, lighting systems, lifting and moving devices and physical protection systems. In three of the rooms, radioactive waste (including SSRS) that do not fulfill the acceptance criteria for disposal at NRRW are stored, while in the other two rooms the degraded cement conditioned packages from Fort building are stored. The high activity SSRS are stored in the four wells located near the storage facility. These wells are provided with lifting and moving devices used for moving the covers and the containers.

SSRS that are of particular importance is Ra-226 and Ra-Be sources. The total estimated amount of Ra-226 in Romania is 50 grams, which is spread at users over all country, at RWTP and disposed at NRRW. Figure 3 shows the distribution of Ra-226 sealed radioactive sources. The main users of these sources include NIPNE, National Company of Uranium NCU, and hospitals. A large quantity of Ra-226 had been disposed at NRRW, of which about 90% are considered radioactive waste and waiting for collection and conditioning for long term storage. Romania has indicated its interest in the IAEA Model Project on Radium conditioning for long term storage.

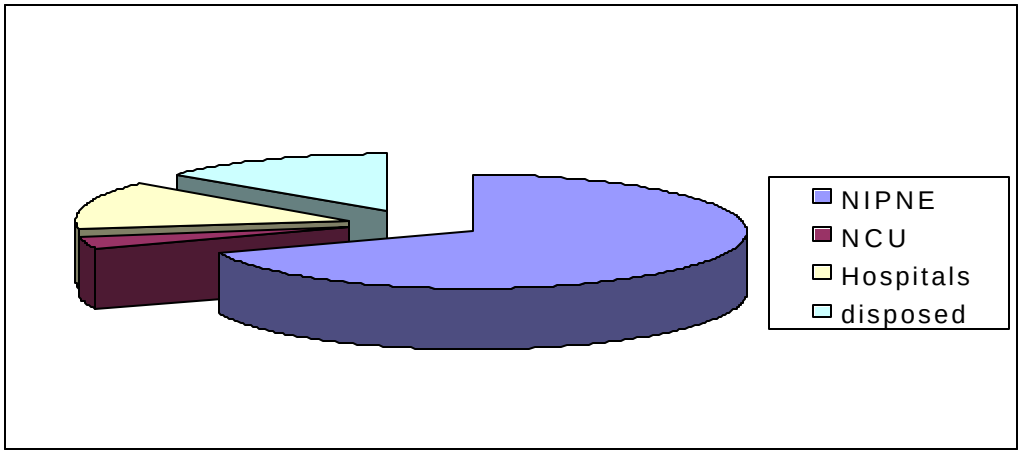


Fig. 3 Distribution of Radium sources

Dispose of SSRS

The National Repository for Radioactive Waste is located at Baita Bihor county about 600 km from Bucharest and is located in an old uranium mine. The facilityconsists of a system of eleven galleries of various lengths, excavated transversally to the central access tunnel at 200m after the entrance, six on its right hand side and five on its left-hand side. The entire length from entrance up to the end of the repository is 230 m. The repository was designed to accommodate a total volume of about 5000 m^3 of conditioned waste, consisting of 21.000 standard packages (200 L) to be extended up to 150000 - 200000 packages. At present only 28% of its capacity is filled.

The system of engineered barriers used in the facility comprises of the waste solidification matrix (cement), the carbon steel container in which the waste packages are emplaced, the special backfilling concrete (bentonite) and the cavity walls (no liner was applied). The bentonite

blanket was only used since 1997, which means that only 313 packages have benefited from this improvement.

A demonstration of the feasibility of the safe disposal of the Romanian radioactive wastes at the Baita, Bihor site was done in 1984, although no safety assessment was issued. The acceptance criteria for disposal used until 1997, were (3):

- Only beta and gamma isotopes are admitted and the maximum activity is 10^3 Ci/m^3;
- The waste must be conditioned in a concrete matrix and packaged in metallic drums;
- The void spaces between packages have to be filled with bentonite, and the storage vaults have to be closed with concrete bricks.
- The dose rate at any point on the surface of the package should not exceed 2mSv/h;
- The disposing of Am-241 SSRS is not allowed.

These acceptance criteria allowed the disposal of a lot of conditioned SSRS with its container at NRRW.

In the absence of an updated Safety Analysis Report, the maximum radioactive content permitted by NCNAC is below the values reported for other engineered repositories in mine galleries. The currently applied values are comparable to those used elsewhere for trench disposal system. The new authorisation issued in 1999 for the repository introduced new acceptance criteria regarding the activity concentration and waste characteristics, as shown in Table I.

Table I. Activity concentration for disposal of radioactive waste

Radionuclide	Concentration (Bq/m^3)
C-14	$30 \cdot 10^9$
C-14 in activated metal	$0.3 \cdot 10^{12}$
Ni-59 in activated metal	$0.8 \cdot 10^{12}$
Nb-94 in activated metal	$0.8 \cdot 10^9$
Tc-99	$11 \cdot 10^9$
I-129	$0.3 \cdot 10^9$
Pu-241	$13 \cdot 10^3$ (*)
Cm-242	$74 \cdot 10^3$ (*)
Ra-226	$0.1 \cdot 10^9$
All alpha emitting nuclides with half-life greater than 5 years, which are not listed in this table	370 (*)
All nuclides with half-live less than 5 years, other than Cm-242	$25 \cdot 10^{12}$
H-3	$1.5 \cdot 10^{12}$
Co-60	$25 \cdot 10^{12}$
Ni-63	$0.13 \cdot 10^{12}$
Ni-63 in activated metal	$1.3 \cdot 10^{12}$
Sr-90	$1.5 \cdot 10^9$
Cs-137	$37 \cdot 10^9$
Nuclides beta and gamma emitting with half-live greater than 5 years that are not listed in this table	$0.1 \cdot 10^9$ (**)

(*) Units are Bq/g;
(**) Exceeding of these values may be authorised by NCNAC after evaluation on case-by-case basis.

Under these circumstances the NCNAC stipulated the necessity of a safety assessment, which is needed for obtaining the license of the repository in compliance with Government policy and international requirements.

After the completion of the safety analysis report, it is expected to increase the activity limits for disposal of radioactive waste. At present, disposal of SSRS is permitted if the activity limits are below the accepted limits. Those that do not fulfil the acceptance criteria are stored unconditionally at the storage facility of RWTP.

CONCLUSIONS

According the national legislation in Romania spent sealed radioactive sources (SSRS) are considered radioactive waste. Accounting, collection, storage, treatment, conditioning and disposal of SSRS are performed by Radioactive Waste Treatment Plant (RWTP) and National Repository for Radioactive Waste (NRRW) in National Institute of Research&Development for Physics and Nuclear Engineering "Horia Hulubei" (NIPNE).

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