PACKAGING EXPERIENCE OF ^{60}Co SOURCES FROM RESEARCH IRRADIATORS

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SUMMARY

After Latvia has used the opportunity to get back its independence the investigations for the former military industrial complex of the big soviet empire have been stopped. These and following economic problems in the newly re-established as independent country have brought to the situation where high activity ^{60}Co irradiation devices for research purposes have been left without necessary operator supervision and maintenance. The situation was aggravated by the fact that Russia, the supplier of ^{60}Co sources had refused to accept back spent sources with expired warranty time. According to official information there were in Latvia at the beginning of 1995 three high activity research irradiation devices with totally 150 sources. Only 48 from them were well suitable (due to warranty time and natural decay) for further use.

By the assistance from IAEA and Sweden Latvia received 2 concrete containers with 5 technological channels in each (Studsvik RadWaste AB design). Because such type of containers was not intended for high activity sources improving of them by adding lead shielding between stainless steel receptacle for sources and external hull in each of the channels was planned and realised by Latvian company "Radons". For the transportation of cobalt sources from devices to storage place the standard soviet design container KT-26-12 belonging to Russian company "Radij" was used. The unloading the sources from transport container to storage container were made by the personnel of "Radij" and "Radons" together. For this purpose a special reloading platform was designed by "Radons" and accepted by state authority. Each of the channels after the loading with twelve sources was planned to close by lead plug. All the reloading operations have been planned in details, accenting radiation safety during transportation and reloading.

However, by starting the operation additional 42 not registered old, no more suitable sources were found in one of irradiators. That have create the problem what to do, because there was place only for 120 spent sources, but suddenly there was 144. There was no financial means and no time left to receive additional concrete containers from Sweden. The situation was rescued by the same Latvian company "Radons" that designed a special concrete drum for 12 sources, with additional lead shielding . The state authority - Radiation and Nuclear Control division of the Environmental State Inspectorate - worked together with the company in the design phase and accepted the design without delay. All the unloading, transportation and reloading operations went successfully. The received doses to the staff were insignificant.

WASTE MANAGEMENT ORGANIZATION IN LATVIA

There is only one radioactive waste disposal facility in Latvia - state company "Radons", located in the central part of the country approximatly 25 km south from the capital Riga. The facility started to work 1962 as a disposal site and designed accordingly to the standart requirements of the former Soviet Union for such facilities. Hovewer, in the eighties some waste treatment - cementation of the liquid waste started. For disposal and storage of radioactive waste there were constructed 5 underground concrete vaults (3 of them (T1, T3 and T6) for dry solid waste with nominal capacity of 200 m^3 each, 2 (T4 and T5) for biological waste with nominal capacity of 40 m^3). Additionally there was a 200 m^3 stainless steel underground tank for storage of liquid waste (T2) - the waste have been removed and cemented. The layout of the site is given in figure 1.

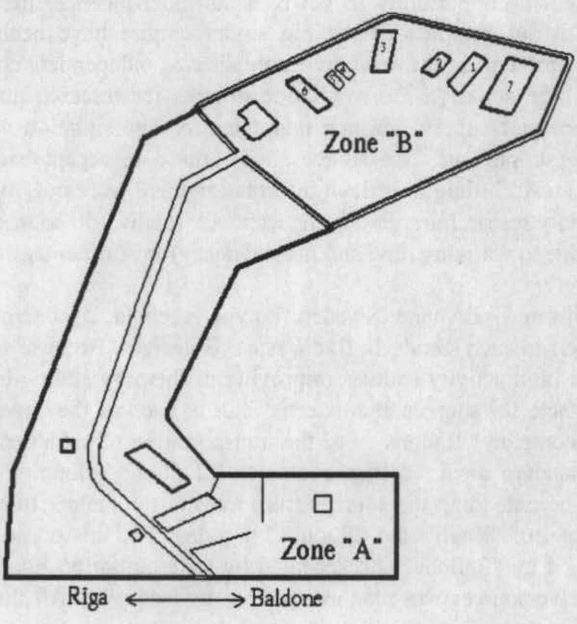


Figure 1. General layout of Baldone site of State company "Radons"

Solid waste usually was disposed without any conditioning in its shielding containers by simple putting them to the bottom of the vault, then a layer of concrete was put in (in 80-ies sometimes using liquid waste by preparing mortar) then again new sources have been thrown in, again a layer of concrete and so on. So each of the old vaults now are representing rather monolithe concrete blocks where short living and long living isotopes have been randomly mixed, because no sorting has been done and required. Short overview about the waste disposed of in old vaults (1, 3-6) are given in table 1.

Table 1.

Vault No.	^{60}Co, TBq	^{90}Sr, TBq	^{137}Cs, TBq	^{226}Ra, TBq	^{239}Pu, TBq	^{3}H, TBq	Total, TBq
1	0.20	0.69	1.16	0.15	0.31	0.07	2.8
3	0.70	1.49	73.7	0.20	0.40	8.64	88.3
4	0.61	0.70	10.0	0.05	0.06	0.19	14.0
5	0.46	0.40	5.3	0.04	0.05	0.97	9.3
6	7.40	4.1	9.5	0.06	2.24	7.43	31.3
Storage (7)	150	15	15	-	1.42	-	181.6
Total, TBq	159.37	22.38	114.66	0.5	4.48	17.3	327.3

When Latvia became again independent the decision was taken that the old technology of disposal of mainly unconditioned waste should be ceased. Instead of cementation in large concrete monolyth blocks the sorting of the waste and preparation of separate packages was considered tob necessary. For low level waste it was decided to use standart 200 l drums in which the receptacle with radioactive waste could be immobilized by cementation.

It must be said that already in the last soviet administration time the construction of new vault complex started with available underground volume ca. 1200 m^3, that was divided by concrete walls in ten 6 m deep separate compartments. The compartments are covered by 0.4 m thick concret panels. In addition in this complex two special disposal volumes for spent sealed sources of comparativly higher activity were constructed. The volumes were made from stainless steel tank with 0.4 m in diameter, 1.5 m high with S-shaped stainless steel pipe with diameter 32 mm to the surface. The tanks have been placed in reinforced concrete wells in 5.6 m depth, the free volume between the tanks and well walls have been filled with special concrete - clay mixture to provide necessary heat transfer. At the end of pipes there were melted source reception funnel designed to fitt with standart soviet design transport - reloading containers. The maximal allowed activity in such final disposal tank was given accordingly to the design $1.1*10^{15}$ Bq (30 kCi).

PROBLEM WITH ^{60}Co SOURCES

In Latvia in the soviet administration time four ^{60}Co research irradiators that had sources even from 1960-ies, have been used. If the sources from one irradiator have been sent back to Russia in 1992 then later it was no more possible because Russia refused to accept back used sources of their origin even if the user decided to purchase new ones. Because the sources in two of irradiators were so old that they became unusable due to natural decay and there was doubts on safety because the given warranty time was exceeded 3 and more times, the plan was made to dispose all old, no more suitable sources, placing the others that still were acceptable in one device. At the beginning it was planned that the above described underground stainless steel tanks for final disposal taking in account comparatively short half life time as an exemption from new waste handling system will be used. But 24 - 28 April 1995 there was an IAEA Waste Management Advisory Mission to Latvia. In the report of the Mission the requirement was given that "the special disposal facility for spent sealed sources should not be taken into operation." Instead of utilizing of underground stainless steel final disposal tanks it was proposed to apply reinforced concrete containers and the new vault as an interim store.

DESCRIPTION OF PROPOSED CONTAINERS

In the same time the technical expert from Studsvik RadWaste AB Karin Brodén have familiriazed with situation in waste management organization in Latvia and suggested to use cubical conteiners similar as designed at Studsvik RadWaste AB. In figure 2. the general view of such container with the lifted lid is given .The outside dimensions 1. 2 m x 1.2 m x 1.2 m.. Each concrete container had five 105 litre technological canals (holes). Taking in account that such type containers have not designed for high activity penetrating gamma radiation (activities with order 50 TBq and more) it was clear that shielding upgrading is necessary. Because acording to information from the irradiator owners there were 102 sources to be disposed of it was assumed that two such containers will be well sufficient - by placing in each canel the receptacle for maximal 12 sources. The number was taken from the fact that in the transport - reloading container KT-26-12 there is a place for twelve sources.

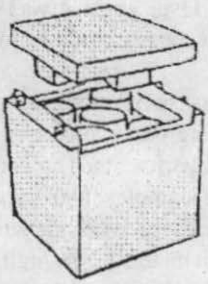


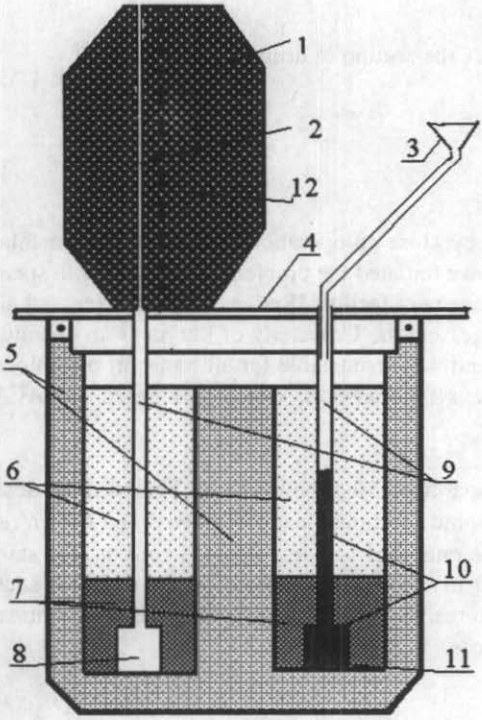
Figure 2. General view of Studsvik RadWaste AB design container

UPGRADING OF CONTAINERS

At first the sources' receptacles for each canal was made. It represents (Figure 3.) cilindrical stainless steel volume (internal diameter 150 mm, height 200 mm, thickness of walls - 5 mm) with welded stainless steel pipe (internal diameter 33 mm, height 80 cm). The receptacle was placed in the middle of cilindrical volume with external diameter 400 mm and height 325 mm that was filled slowly layer by layer with overheated melted lead. Such approach ensured that rather homogeneous lead shielding with thickness 120 mm have formed. Before the placing in container technological canal each source receptacle with welded pipe was tested for hermeticality by using ten atmosphere pressure. After the placing of shielded receptacles in container the space in holes above lead was filled with concrete for additional shielding. It was decided after each receptacle will be filled with sources to fill all the empty rceptacle and welded pipe space with grains of small lead shots. For this purpose a special funnel as schematic shown on the Figure 3. was designed. Each pipe after filling was closed with lead plug.

DRUM-CONTAINER

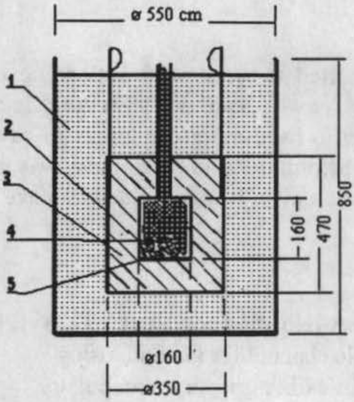
When the expert team from Russian company "Radij" started to work with outloading of irradiators they discovered that in one of them behind the "new" (made in 1989) are 42 not accounted sources (made in 1977). So there was necessity to have more containers to have possibility to dispose all sources. The reloading container belong to "Radij", so there was no time to negotiate the purchase of additional container from Studsvik. It was decided to make a special drum-container for 12 sources (Figure 4.).



1) transport-reloading container KT-26 -12
2) passable channel for loadind, using special flexible gripper mannipulator
3) funnel with connecting pipe for adding grains of small lead shots
4) special designed reloading table from 10 mm thick steel with holes for the receptacle pipes
5) container reinforced concrete framework (the bootom wall 140 mm, external sidewall 100 mm thick)
6) filling of technological canals with concrete
7) lead shielding of receptacle
8) source receptacle
9) welded pipe to receptacle
10) filling with grains of small lead shots
11) sources at the bottom of receptacle
12) revolwing blockwith twelve source pockets

Figure 3. Lateral section of improved container

In the design of drum container the mistake made by improving the Studsvik containers was averted - there is lead shielding at the bottom of receptacle too. By loading the same loading plate was used.



1) concrete filling (at the bottom 120 mm)
2) cilindrical volume
3) lead shielding
4) sources with already heaped up lead
5) source receptacle

Figure 4. Cros-section of drum-container

CONCLUSIONS

All the design and procedures were work out by close co-operation of State Environmental Inspectorate as a supervision authority which have initiated the problem what to do with spent cobalt sources, with the radioactive waste management facility "Radons", which discussed all the procedure and details already in design stage, and the University of Latvia as an operator of irradiator, which assisted with calculations and was responsible for all transport operations according to requirements of interim regulations for transport, which was based on IAEA Safety Series 6 requirements

The storage containers were situated in the compartment 10 of new 7.vault. The maximal dose rate level at available surface after the adding some additional lead bricks were 0.5 mSv/h (at ground level). At the top of containers the dose rate level was less then 0.1 mSv/h. The staff received unsignificant doses not greater as 20 ìSv. The whole operation showed that such approach with working together helped find and realize the acceptable solution even in critical situations as by discovering not known 42 sources.

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