

Assessment of the Clearance Options for NORM-waste

LUST M.

¹*Institute of Physics, University of Tartu, Riia 142, Tartu, Estonia*

Abstract. This paper gives the overview of the assessments done for the clearance of the NORM-waste arising from the production of the rare earth and rare metals in the Silmet plant in Sillamäe, NE Estonia.

KEYWORDS: *NORM-waste, clearance, safety assessment*

INTRODUCTION

The Sillamäe Metallurgical Plant is located at Sillamäe, in North-East Estonia, about 190 km from Tallinn. The Plant was built in late forties and target product was uranium. Since 1990 the main activity of the plant has been the continuation of the production of niobium and tantalum metals and light rare earth metals as well as compounds from various imported ores, e.g., columbite and chloride melts. Composition of raw materials varies depending on deposit and niobium/tantalum are combined usually with iron, tin, titanium, manganese, radioactive elements (uranium, thorium) and their decay products.

Waste arising from uranium production was stored in a depository located near the Sillamäe plant, 20 - 50 m from the waterline of the Baltic Sea. Until 2004 all radioactive waste from the rare earth and the rare metal production is dumped in the tailings pond; however it is not any more available for dumping the radioactive waste produced by the plant. From this followed the need to work out new waste management options for the waste produced.

NORM-WASTE MANAGEMENT OPTIONS

Based on the radiation activity licence number 08/004 the plant is allowed to produce annually up to 48 tons of radioactive waste, which contains naturally occurring radionuclides (NORM-waste). The activity concentration of that waste has to be lower than 300 kBq/kg. The production of NORM-waste is not constant and depends a lot from the production lines and ore used. There is a bit more than 31 tons of NORM-waste in the temporary storage and their U-238 and Th-232 average specific activities are respectively 98.8 Bq/g and 36 Bq/g. The composition and amount of technological waste from the processing depends on the share of each raw material type in the total amount of raw material to be processed and as they contain small amounts of thorium, and uranium as well as products of their decay.

According to the Radiation Act the producer of the radioactive waste has to give it over to the radioactive waste management operator in at least 5 years. Unfortunately there is no radioactive waste management operator for NORM-waste available in Estonia. At the moment the NORM-waste produced by AS Silmet is stored temporarily and the plant has been looking for the possible solutions for the future management. There has been active search by AS Silmet for the further use of the NORM-waste. Unfortunately there is so far no success, as the amount of the NORM-waste produces is really small for further processing and the specific activities do vary a lot. One of the more realistic management options proposed is clearance of NORM-waste at certain conditions. The plant has functioning power plant, which uses local oil-shale for producing of energy. The estimated annual production of the oil-shale ashes is around 100 000 tons. Estonian Environmental Board allowed using oil-shale ashes in the construction process of Sillamäe harbour, which is built close to the old radioactive tailing pond. It is

estimated in the Environmental Impact Assessment of the Sillamäe Harbour that about 8,45 million m³ of the stuffing material is needed in the harbour building process and about 2-3 million m³ of it will be oil-shale ash. Taking account that the activity concentrations and physical properties of oil-shale ash and the NORM-waste produced in Sillamäe are very similar, there is a clearance assumption made that NORM-waste and oil-shale mix (110000 tons of oil-shale ash together with 48 tons of NORM-waste) could be used instead only of oil-shale ash in the construction of the harbour, as the possible management option for the waste.

RESULTS

Based on the Radiation Act of Estonia the clearance levels for the radionuclides, both for U-235 and Th-232 it is 1 Bq/g. The legislation also states that clearance of the radioactive waste is possible if:

- the public annual dose caused is lower than 0,01 mSv;
- the collective annual dose caused is lower than 1 manSv;
- in the case of the NORM-containing material and waste the public dose caused has to be lower than 0,3 mSv.

The assessment of the annual public and collective dose caused by using the oil-shale and NORM-waste mix in the construction of Sillamäe harbour was performed. For the assessment of the clearance options of NORM-waste it was taken into account that future radioactive waste arising is caused exclusively by the production process of AS Silmet. During the assessments programs used were: MicroShield TM 6.02, PRESTO-EPA and DanD. The assessment of the doses was done for both workers and the public and the following scenarios were considered in the assessment:

- 1) transportation of NORM-waste;
- 2) inhalation in the process of NORM-waste management;
- 3) ingestion in the process of NORM-waste management;
- 4) fire in the waste management facilities;
- 5) doses to the harbour workers;
- 6) dose to the farmer, who lives and farms on the harbour area.

For the workers the highest doses arise through the inhalation. For the public the highest doses arise to the farmer, who lives and produces in the area. However, even in the case of the farmer the clearance requirement - annual dose lower than 0,3 mSv, is fulfilled with the probability of 95%. Taking into account that the harbour is been built next to the old radioactive waste tailing, it is hard to believe that farming is a very realistic scenario.

CONCLUSION

Based on the assessments performed it was proved that in case using the NORM-waste and oil-shale ash mix on the construction of Sillamäe harbour, the clearance requirements is fulfilled. Additionally it can be easily proved that such kind of management option could be the optimal solution for such kind and amount of the radioactive waste. The final solution for the NORM-waste management is still under the discussion.

ACKNOWLEDGMENT

This work has been partially supported by graduate school „Functional materials and processes“ receiving funding from the European Social Fund under project 1.2.0401.09-0079 in Estonia.