Clearance and Recycling of Very Low Level Radioactive Waste: an ALARA practice?

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International guidance

The clearance of radioactive materials has been a deeply discussed topic over the latest years. International organizations such as IAEA - BSS, RS-G-1.7, TecDoc 855 - or EC - EC Directive Euratom/96/29, Radiation Protection guides - provide guidance and recommendations for the clearance of such materials. This guidance is systematically based on the following dose criteria: individual dose to any member of the public must be kept below 10 $\mu Sv.year^{-1}$ and collective dose under 1 $man.Sv.year^{-1}$. Associated level of activity for any radionuclide can be derived from those criteria and from different exposure scenarios. Examples of unconditional clearance levels, which are recommended by the international organizations, are given in Table 1.

Table 1. Examples of clearance level

Radionuclide	AIEA Clearance level RS-G-1.7	EC Clearance level RP 122 part 1
^{3}H	100	100
^{58}Co	1	0.1
^{60}Co	0.1	0.1
^{235}U	1	1
^{238}U	1	1

The French context

The French regulatory context for the management of radioactive materials and waste is described in the National Plan for the Management of Radioactive Material and Waste (*Plan national de gestion des matières et des déchets radioactifs*, PNGMDR).

The Nuclear Safety Authority (ASN), as detailed in PNGMDR, has decided that any material entering the nuclear activities regulatory scheme must be at least considered as a very low level radioactive waste, as it may have been in contact with radioactive contamination, or activated. There is no "universal" clearance level within the French regulation, but the possibility to recycle within the nuclear industry very low level radioactive material is discussed: "*For particular cases, for wastes with a very low quantity of radioactivity, recycling within specialized facility may be considered*", e.g. the door is open under specific circumstances.

Recycling of low level radioactive material: a practical case study - 1

Feursmetal, a foundry located in Rhône-Alpes, France, asked the Regional direction for industrial and research activities and environment (DRIRE) for an official authorization to test the possibility to recycle after decontamination low level radioactive metals (containing uranium, mass activity lower than 1 $Bq.g^{-1}$) from SOCATRI (AREVA group). If the test was conclusive, it could in fine lead to the recycling of 200 tons of material per months (compared to the 15 000 tons which are treated per year). Calculations with conservative hypothesis showed that occupational doses would be kept lower than 30 $\mu Sv.year^{-1}$, doses to population living around the foundry would be lower than 1 $\mu Sv.year^{-1}$ and end-users of the final product would receive doses lower than 1.6 $\mu Sv.year^{-1}$. Traceability of final product would be ensured with "common" quality insurance protocol.

After consultation of ASN and different administrations (Health and Safety Affairs, Work and Employment Directions, etc.), a decree by the local representative of the French government authorized Feursmetal to carry out the test. The text defined different obligations among which the follow-up of radioactivity at the work places. In addition, the management of wastes generated by the process was also tackled.

Despite these cares, the decree led to a massive opposition among Feursmetal workers and the local population, with the support of national NGOs. Reasons for the opposition relied on concerns regarding health effects associated with the dissemination of radioactivity in the public domain and a legal demand to cancel the decree was addressed to the tribunal.

The management board of Feursmetal finally decided, in February 2005, not to go further in the project, even if the tribunal did not cancel the decree.

Recycling of low level radioactive material: a practical case study - 2

The development of dismantling activities at the CEA in Marcoule site has led to the production of large amount of wastes, including large quantities of lead with very low level of radioactivity (2 500 tons). The lead can be stored at the very low level radioactive waste storage facility managed by the National Agency for Radioactive Waste Management (ANDRA). Nevertheless, quantities to be stored are limited due to the chemical toxicity of lead. These considerations, as well as the potential for re-use of lead within the nuclear sector and the existing furnace facility at the Marcoule site, have led the Marcoule RP department to engage a reflection on the conditions to create a sustainable procedure for the recycling of lead with very small amount of radioactivity (mainly uranium contamination). The following benefits could be expected:

- Decrease in waste production,
- Recycling of a toxic waste,
- Economic benefit regarding waste packaging and storage,
- Economic benefit regarding "raw" materials.

Different stages were necessary in order to implement the procedure elaborated by the CEA.

The Marcoule furnace can be used to melt lead and reach an average 0.5 $Bq.g^{-1}$ contaminated (uranium contamination) lead. Re-use of lead needs an industrial founder specialized in lead melting in order to produce materials such as biological shields. The D'Huart Industrie operator, located in the south east of France, agreed to partner CEA and to prepare a common project to be discussed with the local authorities. The corresponding project was presented in December 2000 to the DRIRE.

Following the December 2000 meeting, the DRIRE asked for a radiological impact study. Based on its RP knowledge and with the help of D'Huart Industrie staff, who were associated to the project as soon as it began, - the knowledge of D'Huart working conditions was a prerequisite for the building of a coherent project -, an assessment was produced. The highest occupational exposure was estimated to 6.3 $\mu Sv.year^{-1}$ and the public exposure was estimated to 1.5 $\mu Sv.year^{-1}$, e.g. under the common dose criteria of 10 $\mu Sv.year^{-1}$. The DRIRE staff thus addressed further demands to CEA and D'Huart Industrie, among which the development of a quality procedure and a public enquiry, which was held in December 2002 and followed by a public meeting in February 2003.

Within the same time, CEA and D'Huart Industrie organized exchanges between their workers. D'Huart Industrie workers were invited to visit Marcoule facilities. This was an opportunity for them to discuss radiation protection practices as well as the follow-up of ionising radiation conditions at the work place and so to acquire, progressively, a radiation protection culture. CEA workers benefited from the D'Huart Industrie knowledge regarding the optimisation of the use of their lead furnace. The recycling scheme included measurements protocols and procedures for the continuous improvement of radiation protection follow-up and decontamination practices.

The advices from ASN and the Environment Ministry were also required by the DRIRE, which finally provides its agreement for the Marcoule lead procedure recycling in May 2003. 23 tons of lead were sent to D'Huart Industrie in July 2003 and the first biological shield with recycled lead were sent to Marcoule in September 2003. So far, 500 tons of lead have been recycled.

Today, the agreement provided by the DRIRE has evolved. Firstly dedicated to CEA Marcoule lead recycling, it has been extended to other operators (mainly EDF and AREVA) and sites. Another reflection has also been engaged on the possibility to extent the recycling procedure to other metallic materials recovered within the dismantling activities (copper, steel and brass).

Discussion

For most of radiation protection professionals, an individual dose of 10 $\mu Sv.year^{-1}$ per year can be considered as meaningless. In this context, the practice of low level radioactive material recycling and clearance is justified.

One the other side, the non-radiation protection professionals do not see the clearance and recycling of low level radioactive material as a harmless practice. The criteria of 10 $\mu Sv.year^{-1}$ and the associated levels of activity are not understood by people who do not have any radiation protection culture: with no further explanations and efforts, the public (workers of conventional industries, population) sees that radioactive materials are released in the public domain with no further control. Clearance as well as recycling can then be considered as questioning practices.

The two case studies indicate that the involvement of stakeholders appears here as a key issue to discuss radiation protection and its optimisation in view of clearing and recycling low level radioactive material. From this point of view, the absence of predefined clearance value can be seen as valuable because it strengthens the need for establishing the debate between low level radioactive material owners, public experts, authority, representative from the recycling operators, environmental organizations, local elected representatives, etc. Such a debate allows to reach an ALARA objective in terms of individual exposure - that might be in some cases higher than 10 $\mu Sv.year^{-1}$ - and to build a social acceptance regarding clearance and recycling of low level radioactive material. Exposure scenarios may also benefit from this debate, in particular in the case of recycling of low level radioactive material.

Regarding the increasing amount of dismantled nuclear facilities, management of low level radioactive material is a key issue for the coming years. Avoiding social blockages must be a priority for public authority as well as nuclear operators. To reach such an objective, there is a need to elaborate dose criteria, societal factors being taken into account, and thus to consecrate resources and time to this debate. It is also needed to reach the commitment of all concerned actors, as for any activity related to radioactive material use. Exposure scenarios must be specific to a particular material and re-use option; individual doses being one dimension of a complex issue dealing also with the becoming of low level radioactive material and their follow-up on the medium/long-term for example.