

Differences in Provisions between Dangerous Goods Regulations and Radiation Protection Regulations for the Transportation of NORM and TENORM in Germany

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ABSTRACT

The transportation of Naturally Occurring Radioactive Materials (NORM) and Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) is often performed in an area of uncertainty where differing definitions contained in Dangerous Goods and Radiation Protection Regulations lead to different interpretations regarding whether this material has to be classified as radioactive material or not. For example, filter residues from public water purification systems may contain an amount of natural radionuclides exceeding concentration limits according to European dangerous goods regulations (ADR), meaning that they have to be transported within the framework of a “Class 7” road transport for radioactive material. But according to the German Atomic Energy Act, this material is sometimes not classified as radioactive. In this field of law a natural radioactive material only has to be considered as radioactive if the material is explicitly listed in the German Radiation Protection Ordinance as a residuum requiring supervision. In cases where it is likely that the disposal or the recycling of the material leads to an annual effective dose above 1 mSv for a member of the public, the competent authority can also enact special measures for the handling of any material. This situation usually confuses the operators of waste depositories or hazardous waste sites. Generally, they have provisions of acceptance which do not allow the dumping of radioactive material. In addition they do not want trucks labelled as radioactive transport entering their terrain for political reasons. On the other hand, it is not appropriate and generally too expensive to store such a material in a repository for radioactive waste. As a consequence of this, there is often no possibility to dispose of this type of material.

Although the transport of such materials can be performed without obstacles, the need to classify it as a radioactive transport causes problems of acceptance. Several approaches to solving this problem are conceivable.

INTRODUCTION

In 2001 regulations concerning natural radioactive materials were implemented in the German Radiation Protection Ordinance (RPOrd) [1]. Before this date only the handling of natural radioactive materials with the aim of utilizing the radioactive properties of the material was regulated in Germany. Due to this amendment radiation protection provisions are now in force for the handling and the transportation of Naturally Occurring Radioactive Materials (NORM) and Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM), for example filter residues from water purification systems (Fig. 1), residues from geothermal power stations or tube incrustation from the oil industry and the processing of raw materials (Fig. 2). In addition to the transport provisions of German Radiation Protection Ordinance, the person responsible for the transport has to comply with the Dangerous Goods Regulations (Class 7 ADR [2]).



Figure 1.
Filter residues from public water purification
Sludge (dry): up to 60 Bq/g Ra-226



Figure 2.
Incrustation from the processing of raw materials
Scale: up to 310 Bq/g Ra-226

Unfortunately, the definition of “radioactive material” is different in each of the regulations. While in the Dangerous Goods Regulations thresholds for the specific or total activity exist for nearly every common isotope to determine whether a material is to be classified as radioactive, there are several specific residues listed in the Radiation Protection Ordinance for which recycling or disposal requires regulatory supervision. There are also differences concerning surface contaminations in both regulations.

In specific cases this situation can lead to different interpretations regarding whether this material has to be classified as radioactive material or not. In most of these specific cases, for example the road transport of filter residues from water purification systems, the material is not radioactive as defined by the Radiation Protection Ordinance but has to be transported within the “Class 7” ADR regulations.

The fact that a material has to be classified as “radioactive” and simultaneously as “non radioactive” is confusing for the public and even for persons working in the field of radiation protection and operators of waste depositories or hazardous waste sites. Especially if you want to deposit such NORM or TENORM material on waste sites the operators of these sites refuse acceptance of radioactive material although there is no legal reason to refuse the material. For political reasons it is not accepted that trucks labelled as radioactive transport enter such

waste depositories. Therefore the codes of acceptance of the waste sites contain provisions not allowing the deposition of radioactive material on the site.

On the other hand, it is not appropriate and generally too expensive to store such a material in a repository for radioactive waste. As a consequence of this, there is often no possibility to dispose of this type of material.

DIFFERENCES BETWEEN GERMAN RADIATION PROTECTION REGULATIONS AND DANGEROUS GOODS REGULATIONS

The focus in this paper is on the differing definitions of “radioactive material” in Dangerous Goods regulations and radiation protection regulations in Germany. The German Atomic Energy Act (AEAct) [3] stipulates that any material has to be considered “radioactive” if its activity or specific activity in conjunction with nuclear energy or radiation protection cannot be disregarded. Article 2 of the Atomic Energy Act states that:

(1) Within the meaning of this Act the term "radioactive material" (nuclear fuel and other radioactive substances) refers to all material containing one or more radionuclides and whose activity or specific activity in conjunction with nuclear energy or radiation protection cannot be disregarded under the provisions of this Act or a statutory ordinance promulgated on the basis of this Act.

An additional provision for material of “natural origin” can be found in the same article of the AEAct:

(2) The activity or specific activity of a substance may be disregarded pursuant to para. (1), sentence 1 above provided that, pursuant to a statutory ordinance promulgated on the basis of this Act,

.....

3. the substance concerned is of natural origin which is not used because of its radioactivity, as a nuclear fuel or to generate nuclear fuel, and is not subject to monitoring under the provisions of this Act or a statutory ordinance promulgated on the basis of this Act.

This means that, in general, natural radioactive material is, without consideration of the specific activity or total activity of the material, not “radioactive” as defined in the Atomic Energy Act.

For some special residues the German Radiation Protection Ordinance (RPOrd) stipulates the need for regulatory supervision during recycling and disposal (Article 97). A list of these materials is given in Appendix XII RPOrd:

- Sludge and sediments from the recovery, processing and reprocessing of oil and natural gas;
- Unconditioned phosphoric plasters, sludge from their preparation, as well as dust and cinder from the processing of raw phosphate (phosphorite);
- Country rock, sludge, sand, cinder and dust from the extraction and preparation of bauxite, columbite, pyrochlore, microlyth, euxenite, copper shale, tin, rare earth and uranium ores and from the processing of concentrates and residues that occur with the extraction and preparation of these ores and minerals, as well as minerals correspond-

ing to the above specified ores that occur with the extraction and preparation of other raw materials;

- Dust and sludge from smoke gas filtering with the primary metallurgic processes in the raw iron and non-ferrous metallurgy.

The competent authority shall release on application residues requiring surveillance for the purpose of a particular utilization or disposal (see Appendix XII RPOrd) from surveillance if the requisite protection of the general public against radiation exposure is ensured (Article 98 RPOrd). If the radiation exposure of members of the public is increased significantly by utilization, recycling and disposal of materials that are not residues in terms of Appendix XII and radiation protection activities are necessary, the competent authority shall take the appropriate measures (Article 102 RPOrd). As a rule, the protection of the general public against radiation exposure is ensured if the utilization or disposal causes an effective dose not exceeding 1 mSv per calendar year.

Analysing the provisions for natural radioactive materials of the German AEAct and the RPOrd, the criteria for the evaluation of whether this material has to be classified as radioactive material or not is the expected annual effective dose for the general public caused by utilization, recycling and disposal of the material. Without taking into account an intervention of the competent authority there are only a few types natural radioactive materials listed in Appendix XII RPOrd which have to be considered radioactive. This is a different approach compared to the Dangerous Goods Provisions.

The definition of “radioactive material” in the Dangerous Goods Regulation, for example in the ADR which is the basic regulation in nearly all European states and several neighbour states outside Europe for road transports, is less complex:

2.2.7.1 Definitions

2.2.7.1.1 Radioactive material means any material containing radionuclides where both the activity concentration and the total activity in the consignment exceed the values specified in 2.2.7.2.2.1 to 2.2.7.2.2.6.

While para 2.2.7.2.2.2 to 2.2.7.2.2.6 cover special provisions e.g. concerning radioactive decay chains, mixtures of different isotopes in materials, isotopes with unknown data, para 2.2.7.2.2.1 contains a table of values of activity concentration and total activity of most of all relevant radioactive isotopes as mentioned in the definition of radioactive material.

For contaminations the ADR outlines additional provisions:

2.2.7.1.2 Contamination

Contamination means the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm² for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm² for all other alpha emitters.

The values of the most relevant isotopes for the classification of natural radioactive materials is shown in Table 1. Material and contaminated goods which do not exceed the values for activity concentration or total activity and surface activity respectively are exempted from the ADR regulations. The basis for the calculation of these values is the IAEA “de minimis concept”, which stipulates that the effective dose for the public should be in the range of 10 µSv per year or lower. But this is conflict with the concept of the RPOrd where 1 mSv per year is the criteria of exemption.

Table 1. Thresholds for the classification as radioactive material or as surface contaminated objects in the ADR for the total activity (A_{tot}), the specific activity (A_{sp}) and the surface activity (A_{surf}). (Progenies of U, Th and Ra isotopes in secular equilibrium are included)

Isotope	A_{tot}	A_{sp}	A_{surf}
	Bq	Bq/g	Bq/cm ²
U (nat)	1E+3	1	0.04
U-238 (all lung absorption types)	1E+4	1E+1	0.04
U-235 (all lung absorption types)	1E+4	1E+1	0.04
Th (nat)	1E+3	1	0.04
Ra-226	1E+4	1E+1	0.04
K-40	1E+6	1E+2	0.4

For specific natural materials and ores there is a additional provision in the ADR:

1.7.1.4 The provision laid down in ADR do not apply to carriage of:

e) Natural material and ores containing naturally occurring radionuclides which are either in their natural state, or have only been processed for purposes other than for extraction of the radionuclides, and which are not intended to be processed for use of these radionuclides provided the activity concentration of the material does not exceed 10 times the values specified in 2.2.7.2.2.1 (b), or calculated in accordance with 2.2.7.2.2.2 to 2.2.7.2.2.6;

For this reason material with activity concentration A_{sp} less than ten times higher than shown in Table 1 is exempt from ADR provisions.

Comparing the German dangerous goods and radiation protection regulations there is a difference in the approach regarding the situations when these regulations have to be applied. But the focus is not on the difference between the ADR provisions and the transport provisions in the German radiation protection provisions as stipulated in the AEAct and RPOrd. It is more on the fact that applying these two regulations to the same material lead to different interpretations regarding whether this material has to be classified as radioactive material or not. This situation often confuses the public, the operators of waste depositories or hazardous waste sites and sometimes even authorities which are not responsible for radiation protection. For these persons it is not comprehensible that there is no clear unique legal definition of a material or good concerning the radioactivity classification.

For most of the natural radioactive materials in Germany the evaluation of the material due to the ADR and AEAct leads to the same result whether this material has to be classified as radioactive material or not. Usually it is not classified as radioactive material, but in several

cases especially with material from regions with elevated radioactivity in the ground you can find the divergence described above.

For example filter residues from public water purification systems may contain an amount of natural radionuclides exceeding the concentration activity limits shown in Table 1 or, if para 1.7.1.4 e) ADR is applicable, exceeding ten times these limits. Since this material is not listed in Appendix XII RPOrd, the material is not radioactive in the legal sense of the RPOrd. In several specific cases the competent authority checked whether the recycling or disposal could lead to an exposure for the public exceeding 1 mSv per year (see Article 102 RPOrd). But in most of the cases the estimated annual effective dose was much lower than 1 mSv. Therefore, regulatory supervision of this material is not necessary. Such material is not classified as radioactive waste; therefore it is not appropriate and generally too expensive to store such material in a licensed interim storage facility and finally in a repository for radioactive waste. It is conventional waste which has to be transported within the framework of an ADR "Class 7" road transport for radioactive material.

ACCEPTANCE PROBLEMS OF NORM AND TENORM WASTE

Although the transport of such materials as described in the example above can be performed without obstacles, the need to classify it as a radioactive transport causes problems of acceptance. This waste, which can be also poisonous, has to be safely disposed in a surface or underground disposal site. Generally these sites have provisions of acceptance which do not allow the dumping of radioactive material. In addition, trucks labelled as radioactive transport entering their terrain are unwanted for political reasons. Even non-radioactive waste from nuclear installations which had passed the clearance procedure and could be transported without ADR provisions was rejected in some cases. As a consequence of this, there is often no possibility of disposal for this type of material.

The executive boards of the water supply facilities which are affected cannot really follow these legal problems. They need an affordable solution for the waste disposal of their filter residues. The water supply facilities want to have a lasting solution covering the availability of disposal options for the future. They have recognized that this is not a radiological, but rather a political problem. Therefore they expect the authorities or politicians to solve this problem.

DISCUSSION AND CONCLUSIONS

Since in Germany nowadays, nuclear power and all related issues connected with the use of radioactivity is in the enhanced awareness of the public it is difficult to solve this problem politically. Even if there is a possibility for disposal of such material at a special site, the resistance in the local public to the disposal can increase very rapidly. In this case it is very likely that the disposal will be stopped under public pressure.

Therefore, the objective should be to achieve a common view of what is classified as radioactive material in the Dangerous Goods and Radiation Protection Regulations. Very important is provision 1.7.1.4 e) ADR because the activity concentration of most of the occurring natural radioactive material in Germany does not exceed this threshold (applying the factor of 10). Unfortunately it is not clear whether this provision is applicable for filter residues from water purification systems, because the process of filtering potable water may be considered as "ex-

traction of radionuclides”. Because of new German regulations concerning the content of Uranium in potable water a few new systems were set up in water supply facilities to filter Uranium for toxicological reasons (Fig. 3).



Figure 3.
Filter system for the reduction of Uranium in potable water
Uranium enriched Anion exchanger: up to 162 Bq/g U-238

In this case the purpose of this procedure is the “extraction of radionuclides”, but not because of the feature of radioactivity. This makes the decision of whether provision 1.7.1.4 e) ADR is applicable problematic. However, there is a new proposal of the Ad hoc working group on the Harmonisation of RID/ADR/ADN with the UN recommendations on the Transport of Dangerous Goods from April 2013 for an amendment of provision 1.7.1.4 e) ADR to clarify this issue:

Natural material and ores containing naturally occurring radionuclides (which may have been processed), provided the activity concentration of the material does not exceed 10 times the values specified in 2.2.7.2.2.1, or calculated in accordance with 2.2.7.2.2.2 (a) and 2.2.7.2.2.3 to 2.2.7.2.2.6. For natural materials and ores containing naturally occurring radionuclides that are not in secular equilibrium the calculation of the activity concentration shall be performed in accordance with 2.2.7.2.2.4.

The implementation of this provision is expected for the ADR 2015. This provision clarifies that for all natural material and ores, even if they have been processed, the factor of 10 can be applied. Excluded are not natural materials, for example all intermediate products from nuclear fuel production. This new provision will mitigate this problem considerably.

For natural materials and ores with an activity concentration exceeding the values given in provision 1.7.1.4 e) ADR there should be also a possibility of exemption related to the nature of a transport operation. However, it seems to be a better solution if additional regulations of the member states to the ADR agreement contain the possibility for the competent authorities to allow exemptions for these transports, rather than creating general regulations within the ADR. To cover all cases, probably the only option is to allow the exemption all transports of natural material and ores independent of the activity concentration from ADR regulations.

Finally, the very low limits for surface contamination with natural radioactive isotopes (see Table 1) can cause similar problems to those laid out above. It seems appropriate to implement a provision similar to 1.7.1.4 e) ADR for surface contaminations with natural radioactivity, or to exclude these contaminations from ADR provisions totally.

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