STATUS AND ISSUES ON DISPOSAL AND STORAGE OF RADIOACTIVE WASTE FROM NON-POWER APPLICATIONS

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Abstract

In most countries the legal and institutional framework for ensuring the safe management of radioactive materials was developed for materials used in the nuclear industry. Usually, the levels of activity in these materials are such that their use will always need to be controlled by the regulatory authorities. The quantities of material that need to be controlled are normally not large except for the increasingly important issue of decommissioning of large nuclear installations.

The above frameworks are now being applied increasingly to other radioactive materials, including naturally occurring materials, where quite different considerations apply. For naturally occurring materials in particular the levels of activity are often smaller than the natural variability of those levels, and the quantities of materials involved can be extremely large. The possibility of being able to reuse or recycle materials released by decommissioning of redundant facilities, and the maintenance of adequate control of disused sealed sources, also relies on the existence of frameworks to ensure public safety. These aspects must be taken into account if optimal use is to be made of scarce regulatory and other resources.

This paper is concerned with how the above issues are addressed in the European Union (EU). It begins by discussing the main legal requirements that apply to activities involving the use of radioactive materials, with emphasis on how these requirements are applied to non-nuclear materials. The paper then considers general arrangements for storage of these materials in EU Member States. Finally, some specific considerations relating to the management of NORM waste in the Netherlands are discussed.

1. INTRODUCTION

In the EU the Euratom Treaty provides the legal basis for the overall framework for radiological protection. This includes a requirement that basic standards are provided to ensure the safety of workers and the general public from ionising radiation and these 'basic safety standards' have been in place since 1959. In the most recent update (see the next section of this paper) requirements are introduced for work activities involving the use of natural radiation sources where the presence of radiation is incidental to the activity - where workers or the public could face significant exposure to radiation. This development is likely to have significant implications for the ongoing development of national approaches for management of radioactive materials.

2. LEGAL FRAMEWORK

The basic legal framework for governing the storage and disposal of radioactive materials will normally incorporate many items of primary and secondary legislation together with guidance on how the legal requirements should be implemented by users and by the relevant regulatory authorities. The legal framework will normally take account of recommendations of international organisations such as the International Commission for Radiation protection (ICRP) and the International Atomic Energy Agency (IAEA). For the purposes of this paper only those overarching requirements related to ensuring safety of human beings (in the form of the basic safety standards) and the environment (in the form of requirements relating to environmental impact assessment) are discussed in any detail.

2.1. Basic Safety Standards

EC Directive 96/29/Euratom [1] is concerned with the protection of workers and the public in the European Union (EU) from ionising radiation and is based (as in most other jurisdictions) on ICRP Publication 60 [2]. It is also broadly compatible with the IAEA's 'Basic Safety Standards' last revised in 1996 [3]. This Directive was also adopted in 1996 and is currently being transposed into the domestic legislation of all Member States and of candidate countries for future membership.

2.1.1. Exemption, clearance and exclusion

The concept of *exemption* is reflected in the EC Directive such that, provided specific radionuclide quantities and concentrations are below specified levels, the relevant *practices*[1] may be exempted from the requirement to *report* to the regulatory authorities. There is therefore no necessity to notify the regulators that the relevant practice is being undertaken, the basic premise being that at these activity levels the radiological impact from such a practice is *sufficiently low as to be of no regulatory concern*. In practice, exemption only applies to practices outside the nuclear fuel cycle.

The basic criteria used to derive the radionuclide-specific exemption values given in the Directive are that individual and collective risks are sufficiently low to be of no regulatory concern, with no appreciable likelihood of scenarios involving enhanced risk levels. The exemption values were derived on the assumption of limited use of artificial radionuclides[2], i.e. they are not intended for application to larger quantities of naturally occurring radionuclides. It should be noted also that the disposal, recycling or reuse of radioactive materials must still be authorised if they arise from a practice that is itself subject to authorisation (or reporting). This requirement can be set aside, however, where the levels of radioactivity are less than clearance levels established by the national authorities – see below.

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[1] i.e. activities involving the use of artificial sources of radioactivity or activities using natural sources where the radionuclides are being processed because of their radioactive properties.

[2] or to very limited uses of natural radionuclides such as their use in sealed sources.

The concept of *clearance* also relates to regulatory control of practices: in this case materials from practices already authorised may be released from regulation provided activity levels are lower than those specified by national regulatory authorities. No specific clearance values are given in either the EC Directive, though it is a requirement that clearance levels derived by national authorities (for practices) should meet the following criteria: (1) individual doses incurred by members of the public should be of the order of 10 μSv or less in a year, and (2) the collective dose should be less than about 1 man Sv.

Clearance values for specific radionuclides have been recommended for EU Member States by a specially constituted Group of Experts established under the terms of the Euratom Treaty [4]. These recommended values are generally between one and three orders of magnitude lower that the exemption levels in the Directive, i.e. the proposed exemption values are applicable to public exposure for all potential scenarios, including reuse and recycling, and regardless of the volumes of material involved. Further discussion of this issue, in the context of national approaches to implementing the Directive, is given in the appendix to this paper.

The concept of *exclusion* is specific to natural radiation: certain categories of exposure are excluded from the Directive and the IAEA Standards on the basis that they are not amenable to control. These include exposure to radon in dwellings and to radionuclides contained in the human body (^{40}K), cosmic radiation and radiation from the (undisturbed) earth's crust.

2.1.2. Naturally occurring radioactive materials (NORM)

Although the EC Directive applies primarily to *practices* it also requires Member States to apply controls to other activities involving exposure to natural radiation. This applies where there is *a significant increase in the exposure of workers or members of the public which cannot be disregarded from the radiation protection point of view* (Art. 40.1). In the Directive these *work activities* are treated as a separate category for the purpose of radiation protection, i.e. outside the ICRP classification of *practices* and *interventions* in ICRP 60 [2]. All such activities that are amenable to control are within the scope of the Directive, with the onus being on national authorities to exclude activities where the reduction in exposure is not justified by the regulatory resources that would be necessary to achieve this.

The exemption levels specified in the Directive for natural radionuclides represent a significant change in concentration levels from the previous (1984) EC Directive [5]. The 1984 Directive allowed general exemption from reporting and prior authorisation for practices involving the use of materials with:

(a) total activities not exceeding levels specified in Annex 1 of [that] Directive; and
(b) activity concentrations lower than 100 Bq/g or, for solid natural materials in their original matrix, 500 Bq/g.

These exemptions could be applied to practices involving bulk amounts of material, e.g. scales and residue from the oil and gas industries. But different regulatory authorities have taken a different view on how the above provisions should be applied in practice [6]. For example, in the context of NORM from oil and gas production, the Dutch authorities decided in 1986 that the 100 Bq/g limit should be applied, i.e. natural radionuclides not in their original matrix should not be regarded as solid radioactive material. Further, total activity (taking account short-lived decay products in radioactive equilibrium) should be included in determining the total radionuclide concentration. By contrast, in Germany, the 500 Bq/g limit has been applied with short-lived decay products not being included in the calculated total activity concentration.

The following table, adapted from [6], compares current and previous concentrations.

Nuclides	1984 Dir[a] Bq/g	1984 Dir[b] Bq/g	1996 Dir[c] Bq/g	NL Reg[d] Bq/g
Ra-226+ (decay products to end of chain)	11	250	10	1
Pb-210+ (Bi-210, Po-210)	33	500	10	100
Ra-228+ (Ac-228)	50	500	10	1
Th-228+ (decay products until end of chain)	14	500	1	1

a) based on application of exempt concentration of 100 Bq/g (as in the Netherlands) and short lived decay products included in the calculated activity concentration

b) based on application of exempt concentration of 500 Bq/g (as in Germany), no short lived radionuclides included in the calculated activity concentration

c) based on assumed application of the new exempt levels for practices in Annex I

d) regulations implementing the 1996 Directive came into force in the Netherlands in July 2001 – see appendix to this paper.

EU Member States have significant discretion as to the identification of the activities covered by the above requirements and in specifying the actions to be taken. Nonetheless, work involving the processing of large amounts of materials containing NORM at concentrations significantly above that of the earth's crust clearly should be considered for inclusion. Such materials include phosphate rock, rare earth metals and scales and sludges from the oil and gas industries.

The basis on which exposures to naturally occurring radionuclides are included within the general system of radiological protection is currently under discussion by various international organisations, including the IAEA where it being considered currently. Pertinent issues include the fact that concentrations derived on the basis of an individual dose criterion of 10 μSv in a year would result in large areas of the earth being brought under regulatory control. As this is clearly impracticable other options are under consideration, e.g. guidance developed by the EC Article 31 Group of Experts relating to building materials [7] is based on an incremental dose (above natural background) of 300 μSv in a year. The Group of Experts is currently developing more general guidance[3] on the application of the concepts of exemption and clearance to work activities (natural radiation sources). It is expected that the

[3] Expected to be published as European Commission Report 122, Part II.

derivation of radionuclide specific clearance values will be based on an individual dose criterion of 300 μSv/year.

The rationality for differentiating between exemption and clearance in the context of NORM (i.e. specifying different radionuclide levels for exemption and clearance) is being reviewed in many countries. This is because (for example) ores containing radioactive material may be both a feed material and a residue from industrial processes. It may be argued that the reuse or recycling of radioactive material constitutes a *practice* and therefore the criterion for clearance of the material from regulation should be the same as that for exemption of the resulting practice.

2.2 Transboundary Movement of Radioactive Waste

EC Directive 92/3/EURATOM [8] establishes control requirements, i.e. for notification and authorisation, for the shipment of waste between individual Member States and into and out of the EU. Sealed sources being returned to suppliers are exempt from the requirements of the Directive. A fuller discussion of the requirements of this Directive and of other more general EU requirements for the management of wastes (radioactive and non-radioactive) is given in [9].

2.3. Environmental Impact Assessment and Public Participation

Environmental impact assessment (EIA) is the process of identifying, describing and assessing the direct and indirect effects of a project on the natural and built environment and on human beings. In the European Union this requirement is addressed in Directive 85/337/EEC as amended by Directive 97/11/EC [10]. In accordance with these Directives EIA is always required before consent is given to establish repositories for disposal of spent fuel or radioactive waste, or for long term storage (i.e. for more than 10 years) of these materials away from the site of production. At the discretion of Member States EIA may also be required for other installations intended to be used for processing and/or storage of radioactive waste.

The Directive requires the developer of the facility to provide information relating to:

- the site, design of the facility and size of the project;
- the measures envisaged to avoid, reduce or remedy significant adverse effects;
- the data required to identify and assess the main effects that the project is likely to have on the environment; and
- (in outline) the main alternatives studied by the developer and an indication of the reasons for the choice of the preferred alternative.

The Directive specifies minimum requirements for the information which should be contained in the report of an EIA and advice is given on how to make the decision as to whether an EIA should take place, a decision process known as *screening*. After screening, the scoping stage establishes the issues that are to be covered by the EIA. In some states the Competent Authority is required by legislation to give an opinion on the scope of the EIA, whether or not the developer requests this. In addition the *scoping* stage may be extended to include the specification of criteria for assessing the significance of any potential impacts that may be identified during the course of the EIA.

The amended EIA Directive pre-dates the United Nations Economic Commission for Europe's 1998 *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters* [11], generally known as the *Aarhus* Convention. This Convention contains stricter public participation provisions rather those in the Directive and, as the Convention has been signed by the European Union and in most countries in Central and Eastern Europe considering membership, the Directive will need to be modified.

The Aarhus Convention establishes that reasonable time-frames for public participation should be employed and this should occur early in the process, when all options are open and effective public participation can take place (Article 6.3). Although this interpretation will be left to the discretion of each Party, in the light of best practice and the EC Guidance, it should be interpreted as allowing for public participation before the EIS is produced and, ideally, during a participative scoping phase [12].

3. CURRENT ARRANGEMENTS FOR STORAGE AND DISPOSAL OF NON POWER WASTES IN THE EUROPEAN UNION

The majority of countries in the EU do not have disposal routes for long-lived radioactive wastes from either the power industry or from other applications. No EU country has a disposal route for spent fuel and high activity wastes although some have made significant progress in this respect in the last 5 years.

The management and disposal of disused sealed radioactive sources has been the subject of a number of recent studies commissioned by the European Commission [9, 13]. As these studies are discussed in other papers at this meeting, and because the installations for management of disused sources, can normally deal also with other non-power wastes, only a summary of storage and disposal facilities is given here. It is noted however that a new Directive is currently in preparation to harmonise and improve control of sealed sources ion the EU.

With the exception of Greece, Ireland and Luxembourg (where wastes are stored at the site where they arise) all countries of the EU operate centralised or regional facilities for the management and long-term storage or disposal of radioactive waste. Although no EU country has yet developed a disposal facility for wastes with high levels of activity, permanent disposal of low activity wastes is being undertaken in five countries: Finland, France, Spain, Sweden and the United Kingdom. The remaining Member States, Belgium, the Netherlands, Germany, Italy, Portugal, Austria and Denmark store national or regional store wastes in central or regional facilities pending the development.

A summary of the main facilities in EU Member States is given below:

- Finland – central disposal site at Olkiluoto comprising silos at a depth of 60-100m below ground. ^{226}Ra sources or other high activity wastes cannot be emplaced in this facility. A site at Olkiluoto is being investigated as a possible location for a permanent geological repository (in crystalline rock) for spent fuel and high activity wastes.

- France – central near surface disposal site at Centre de l'Aube for short-lived and low-level wastes and not including sealed sources. The latter are stored in a long-term interim storage facility at Saclay. The possibility of siting a permanent deep disposal facility in a clay host is being investigated at Bure in Eastern France.

- Spain – central near surface disposal site at El Cabril for short-lived radionuclides including sources. High activity sources are placed in separate long-term storage facilities. No potential sites for permanent disposal of high activity wasters are being investigated.

- Sweden – central disposal site (mined cavern) at Forsmark for (primarily) short-lived wastes including small sources. Higher activity sources are stored in a centralised long-term storage facility at Oskarshamn. Three locations in crystalline rock in South Eastern Sweden are being investigated as potential locations for a permanent geological disposal facility.

- United Kingdom – central surface disposal facility at Drigg for (primarily) short-lived wastes. Most sealed sources are kept in a centralised long-term storage facility at Harwell. No potential sites for permanent disposal of high activity wastes are being investigated.

- Belgium – centralised interim management and storage facilities at Mol. Ongoing research on the suitability of clay as a disposal medium is being conducted at Mol but no potential sites for permanent disposal of high activity have been identified.

- Netherlands – centralised interim management and storage facility at Borssele. No potential sites for permanent disposal of high activity wastes are being investigated.

- Germany – interim storage facilities exist in 14 of the 16 States (i.e. except in Sachsen-Anhalt and Thüringen). Waste conditioning is undertaken prior to waste being received at the storage facilities. No potential sites for permanent disposal of high activity wastes are being investigated.

- Italy – wastes, including disused sources, for which decay storage is not appropriate are placed in a centralised national storage facility at the La Casaccia Research Centre near Rome. No potential sites for permanent disposal of high activity wastes are being investigated.

- Portugal – disused sources are kept in a long-term storage facility at Savacem. No potential sites for permanent disposal of high activity wastes are being investigated.

- Austria – a national waste management and storage facility for radioactive wastes including sealed sources is operated at Seibersdorf. No potential sites for permanent disposal of high activity wastes are being investigated.

- Denmark – radioactive wastes are placed in long-term storage in one of two facilities at the Risø National Laboratory, one being an underground store for high activity waste and one above ground store for containers with low surface dose rates. No potential sites for permanent disposal of high activity wastes are being investigated.

4. SOME CURRENT TOPICAL ISSUES IN THE MANAGEMENT OF NORM WASTES

4.1 Introduction

NORM arises in various industrial processes in which raw materials containing radionuclides from the natural decay chains of uranium and thorium are being used. It appears as radioactive scaling in process equipment and as process residues with enhanced radionuclide concentrations. Examples of these industrial processes are the production of phosphate, iron, phosphate fertiliser, titanium oxide pigment and oil and gas. Two specific NORM topics of current concern in the Netherlands are scales and sludges (from the oil production industry) and mineral wool (from various process industries) and these are discussed below by way of illustration of the wider issues arising from the adoption of the 1996 EU Directive.

4.2 Scales and Sludges from Oil and Gas Production

The production process for oil and gas involves the mobilisation of radionuclides from the reservoir rock which are subsequently deposited as scales in the transport pipework and other equipment, or are contained in sludges after separation of the oil/gas, or that remain in the ‘produced’ water. The mixed solids in such sludges contain highly variable concentrations of natural radionuclides from the ^{238}U and ^{232}Th series and daughter radionuclides, primarily ^{226}Ra, ^{228}Ra and ^{210}Pb and ^{228}Th. These sludges also contain sand and clay from the reservoir, various hydrocarbons and heavy metals, including mercury at often very high concentrations. As the total concentration of NORM nuclides will often exceed the revised limit for classification of radioactive material, the sludge must in principle be treated as radioactive waste.

There are currently no licensed facilities, in the Netherlands or elsewhere, capable of conditioning radioactive sludge for safe long-term storage. As the sludge cannot be stored for an extended period in untreated form, a substantial research programme is underway in the Netherlands on appropriate treatment options. In particular, facilities have been developed for the extraction of ^{210}Pb from the sludge. Work is currently being done to assess the feasibility of building and operating a sludge treatment facility and initial results and substantial progress is being achieved.

There is also extensive experience in the Netherlands in the cleaning and decontamination of equipment used in the oil and gas production industries, including pipework, pumps, valves, separators, heat exchangers and tools. A variety of techniques are used including chemical decontamination, sand or glass blasting and high pressure water jetting. Water jetting has been found to be the most efficient method for removal of radioactive scale and it is considered that, over time, this technique will replace chemical decontamination [6].

4.3 Mineral Wool

Mineral wool is and has been used on a large scale as high-temperature resistant insulation material in industrial installations. When these installations are dismantled metal components are sold to scrap dealers for recycling. Most of the larger scrap dealers employ portal monitors to check delivered scrap loads for radioactive sources, which would pose serious radiation and economic risks. Recent experience in the Netherlands indicates that scrap with mineral wool may trigger portal monitor alarms and there have been a number of recent examples where certain types of mineral wool has contained natural radionuclides at concentrations exceeding current national limits for classification of radioactive material.

The precise origin of the mineral wool is not clear, except that it was applied twenty to thirty years ago in a variety of installations. These range from small steam generators, bakers' ovens, industrial ovens and large coal fired power plants. Dismantling these installations now poses serious regulatory, practical and economical problems. According to Dutch law the mineral wool, once safely separated from the installation components, must be delivered for storage at the national storage facility at Borssele. Options for better management of this waste, taking account of economic, safety and environmental considerations, is the subject of ongoing research.

5. CONCLUSIONS

It is apparent that the adoption in 1996 of the revised Basic Safety Standards Directive will have significant implications for the management of wastes from non-power applications. The scope of the Directive extends in principle to all work activities (involving the use of material with radioactive properties) that are amenable to control, though allowing discretion to national authorities to conclude that such control is not justified.

Member States have discretion to establish limits below which materials will no longer be subject to regulatory control (clearance levels). For naturally occurring materials it is impracticable to apply the same criteria to define the boundary between radioactive and non-radioactive materials (e.g. an individual dose level of 10 μSv per year), as otherwise large amounts of the earth's surface would be brought within the regulatory system. Nonetheless, even using more practical criteria (e.g. an annual incremental dose level of 300 μSv) it is clear that, in many countries, there will a significant increase in the quantity of natural materials being brought under regulatory control. This paper has considered some of the implications of this significant development.

It is apparent that significant advances have been made in recent years, not only in the implementation of more robust regulatory frameworks but also in the practical development of techniques for the management of non-power wastes and of facilities where radioactive wastes of all types can be stored. There has also been significant progress in a few countries in the development of final disposal facilities.

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APPENDIX

NATIONAL APPROACHES TO ADOPTION OF THE EC 'BASIC SAFETY STANDARDS' DIRECTIVE

The process of transposing the EC Directive into national legislation is not yet completed; this will be the subject of an EC-commissioned study expected to take place in 2002. Some aspects of the approaches being followed in two countries, the United Kingdom and the Netherlands are discussed here to give an indication of the issues being addressed as part of this process.

The Netherlands

Although the Netherlands does not have large amounts of high activity waste from its commercial nuclear programme it does have to manage large amounts of NORM including wastes resulting from oil and gas production on the Dutch Continental Shelf. New Regulations are expected to be approved before the end of 2001 and will deal extensively with this issue.

The basic approach being taken to clearance and exemption is to establish a uniform set of radionuclide specific concentrations and total quantities that are used to establish both clearance and exemption. No distinction is made between the levels for natural sources and for artificial sources or for levels on site and off site, i.e. there is no distinction between workers and members of the public for the purpose of defining clearance levels.

To a large extent the exemption levels given in the Directive are being applied as exemption/clearance levels in the new Dutch Regulations [1]. But in order to arrive at common values for clearance and exemption some adjustments are made to those radionuclides that occur naturally – see the following table.

Exemption and Clearance Levels for *Practices* (Natural Radionuclides)

Nuclide	**EC Directive** *Exemption levels (for reporting)*	**EC Article 31 Group of Experts**[4] *Clearance levels*	**Revised NL Regulations [1]** *Exemption and clearance levels*	
			Reporting	**Authorisation**
Ra-226+	10 Bq/g	0,01 Bq/g	1 Bq/g	10 Bq/g
Ra-228+	10 Bq/g	0,01 Bq/g	1 Bq/g	10 Bq/g
Ac-227+	-	0,01 Bq/g	1 Bq/g	10 Bq/g
Po-210	10 Bq/g	0,01 Bq/g	100 Bq/g	1000 Bq/g
Pb-210+	10 Bq/g	0,01 Bq/g	100 Bq/g	1000 Bq/g
Th-228+	1 Bq/g	0,1 Bq/g	1 Bq/g	10 Bq/g

In the view of the Dutch authorities the reduction in levels for certain radionuclides will not lead to any significant increase in the scope of regulatory involvement. The

[4] European Commission Report Radiological Protection 122 (Part I) – see Reference 4 of main paper.

increased levels for ^{210}Po and ^{210}Pb and daughters reflect a view that disposals of wastes containing nuclides at these activity levels are not of regulatory concern.

Although the clearance and exemption levels have been unified the new regulatory framework for natural sources includes distinct requirements for reporting and for authorisation; for artificial sources only authorisation is relevant. As regards natural sources, therefore, the clearance/exemption levels apply to the requirement to report a work activity to the regulatory authorities (as envisaged by the Directive). To determine whether that activity should be authorised the following levels are applied:

- activity concentration - factor of 10 times the clearance/exemption activity level in the Regulations; and

- total quantity - factor of unity times the clearance/exemption quantity level in the Regulations

As was discussed above it will no longer be possible for activities to be given a general exemption on the basis 100 Bq/g concentration level. In particular, the new exemption levels will be significantly more restrictive for substances containing ^{228}Th as a progeny of ^{228}Ra[5], where the reduction is more than a factor of 10, to 1 Bq/g.

United Kingdom

By contrast to the rather extensive changes being made to the legal framework in the Netherlands the UK authorities have, following consultation, decided that few changes are needed to the regulatory regime in the UK. To a large extent this is because UK legislation has in practice for many years included a system of clearance levels both for natural and artificial sources, though the term ‘clearance’ is not used explicitly.

The UK’s Radioactive Substances Act 1993 defines activity levels at which naturally occurring substances are considered to be radioactive – see table below for naturally occurring radioelements in solids. The values are expressed in terms of the total radioactivity of the element, i.e. of the sum of the concentrations of all the radionuclides of that particular element and including the natural background levels. Also, where more than one radioelement is present, the limits are applied independently to the material under consideration, i.e. not additively. This latter approach differs from that applied in the Directive, which requires that a summation rule be applied.

A recent study commissioned by the UK Government [2] concluded that applying the above activity levels would result in maximum individual dose levels of some tens of microsieverts per year for all reasonable exposure scenarios. That is, the study found that current levels were broadly compatible with the basic criteria for exemption of practices as stated in the Directive – individual and collective risks should be sufficiently low to be of no regulatory concern.

[5] In radium scales ^{228}Th grows in as a progeny of ^{228}Ra until a constant activity ratio with ^{228}Ra is reached. From that point both activities decrease with the half life of ^{228}Ra.

Activity levels for naturally occurring radioelements in solids and liquids (Radioactive Substances Act 1993)

Element	Activity level (in solid) (Bq/g)	Activity level (in liquid) (Bq/g)
Uranium	11,1	0,74
Protactinium	0,37	0,033
Thorium	2,59	0,037
Actinium	0,37	0,074
Radium	0,37	0,0004
Polonium	0,37	0,026
Lead	0,74	0,004

As regards artificial sources, it has been the position since the introduction of the Substances of Low Activity (SoLA) Exemption Order in 1986 [3] that solid waste containing any radioactive materials at concentrations less than 0,4 Bq/g should be exempted from any requirements for registration or authorisation. Where the waste contains materials of natural origin the 0,4 Bq/g limit is still applied regardless of the activity levels for specific radioelements in the Radioactive Substances Act (as discussed above).

Studies commissioned by the UK Government [4] concluded that the radiological consequences of continuing to apply a clearance level of 0,4 Bq/g for all radionuclides would normally lead to individual doses of less than 10 µSv per year. For the most extreme case considered the maximum dose was calculated to be 40 µSv per year. On that basis the Government decided to retain the existing system rather than introduce nuclide specific clearance levels.

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