

Assessments in support of UK Review of Exemption Orders for Radioactive Waste



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14 May 2012

To support UK Govt's 2009 review of Exemption Orders (EO)

This review has now been implemented

- Environmental Permitting Regulations (England and Wales)
- Amended Radioactive Substances Act (Scotland and Northern Ireland)

Previous legislation and exemption orders



The UK's Radioactive Substances Act, 1993 (RSA93) controlled keeping and use of radioactive material and accumulation, storage, and disposal of radioactive waste

Exemption orders (EO) under this Act gave exemption from registration and /or authorisation for storage or disposal

Most EOs contained conditions. Typically these were limits on the quantity or activity concentration

Why review them?



Ad hoc system, developed to meet needs as they arose

Archaic terminology

Inconsistent conditions eg amount disposed of per week/month

Out of date: need to be 'interpreted' to cover modern equipment and materials

Dose/risk basis unclear as they were developed ages ago

Overall aim - Simpler set of exemption orders, informed by risk, more easily linked to EC Basic Safety Standards (1996)

Principle: If it gives trivial doses then do not subject it to unnecessary regulations

- Exclusion – deliberate exclusion of a particular category on grounds that not amenable to control
- Exemption – source or practice not subject to some or all aspects of regulatory control. Values given in EC Basic Safety Standards Directive
- Clearance – removal of radioactive materials or objects within authorised practices from further regulatory control. EC has published clearance levels in RP122 Parts 1 and 2

Advice on exemption levels and clearance

Radiological assessments in 1990 review

Technical review panel to evaluate responses and suggest way forward

Stakeholder workshops, as a stakeholder

Response to consultation documents

Radiological assessments specifically for the new regime

- Norm disposal to landfill
- Aqueous liquids
- Non aqueous liquids
- Norm gases

Radiological advice on proposals

Exemption levels for NORM waste



Investigated amount of NORM waste (^{238}U , ^{235}U and ^{232}Th) with head of chain activity conc of up to 5 Bq g^{-1} that can be disposed of to landfill without exceeding dose criteria

Also considered segments of the chain eg ^{226}Ra

Assumed secular equilibrium

Landfill assumptions



Accepts inert waste ie has simple design with liner but no cap

Capacity of 2.2×10^6 tonnes

Lifetime of 15 years

3 consignors of NORM waste



Exemption levels for NORM waste



Exposure scenarios considered

- Landfill workers during operation to site
- Public exposure due to migration into drinking water
- Following closure of site and assuming redevelopment 30 years later for residential housing
 - Inadvertent intrusion
 - Inhalation of radon

If sum of head of chain activity conc for three natural decay chains $\leq 5 \text{ Bq g}^{-1}$ then dose criteria met assuming that;

- Annual disposal limit of 10 000 t of NORM waste per consignor
- Corresponds to a activity limit of $5 \cdot 10^{10} \text{ Bq}$ per consignor
- Activity conc is head of chain activity conc or maximum activity conc in chain *rather* than total in each chain

Results (given in HPA-CRCE-001) are directly incorporated into revised legislation

Exemption levels for aqueous liquids



Asked to calculate activity conc for aqueous liquids that could be used as either exclusion or exemption levels

Difference between exclusion (out of scope) and exemption?

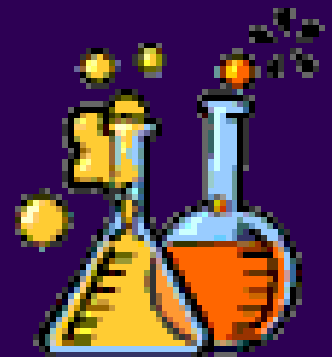
Exclusion has no conditions ie unlimited amounts

Exemption has conditions ie limits on quantities

Based on dose criteria of:

- $10 \mu\text{Sv y}^{-1}$ for most highly exposed individuals
- Collective dose of 1 manSv per practice

Over 270 radionuclides considered



Activity conc derived using simplified HPA methodology used to calculate generalised derived limits (GDLs) in environmental media

Exposure pathways considered:

- Ingestion of drinking water and fish
- External irradiation from contaminated river sediments

Values for 84 radionuclides calculated using the UK Environment Agency's methodology and found to be in good agreement

Quantity of liquid containing these activity conc levels that could be disposed of to sewage treatment works were also calculated using a range of models

HPA proposed a volume restriction of $3 \times 10^3 \text{ m}^3 \text{ y}^{-1}$ of aqueous liquids that can be disposed of to sewers ie a radionuclide independent value would be suitable for exemption

Later discussions with UK Government and Environment Agencies resulted in revised legislation containing different allowable quantities for different groups of radionuclides

Radionuclide specific activity conc calculated in HPA-CRCE-005 are used in the revised legislation

HPA-CRCE-005



Centre for Radiation, Chemical and
Environmental Hazards

Derivation of Liquid Exclusion or
Exemption Levels to Support
the RSA93 Exemption Order Review

L W Ewers and S F Mobbs

Exclusion levels for NORM liquids and gases



Exclusion levels for liquids were derived using HPA GDL methodology but using a dose criterion of $300 \mu\text{Sv y}^{-1}$ (so as to be consistent with EC guidance on NORM waste RP122 Part 2)

Exclusion levels for NORM gases were derived assuming a dose criterion of $300 \mu\text{Sv y}^{-1}$. Inhalation and external exposure pathways were considered.

The derived exclusion levels were directly incorporated into revised legislation

Exclusion levels for non-aqueous liquids



What are they?

Oils, solvents, organic liquid scintillants, mercury

What was the question?

Could the exclusion levels for solids (Bq g^{-1}) given in RP122 Part 1 also be used for exclusion or exemption of non-aqueous liquids

Exclusion levels for aqueous liquids are not relevant because they include direct consumption of the liquid which will not happen

Two methods to identify whether RP122 Part 1 values are suitable

- 1) Perform simple generic dose assessment for some example non-aqueous liquids (organic liquid scintillants, oils and mercury)
- 2) Determine whether parameter values used in RP 122 Part 1 encompass range of possible scenarios for disposal and recycling of non-aqueous liquids

Five different legislative options are discussed in HPA-CRCE-006

It was concluded that EC clearance levels for solids were appropriate for defining exclusion for non-aqueous liquids

Incorporated into revised legislation in the provision for 'relevant' liquids



- **HPA-CRCE-006**
- **Investigation of Possible Exemption or Exclusion Levels for Non-aqueous Liquids to Support the RSA93 Exemption Order Review**
- **SF Mobbs**

Results of assessments and discussions incorporated into new legislation

Dose/risk informed legislation

New legislation

- Environmental Permitting Regulations 2011 for England and Wales
- RSA 93 amended 2011 with one Radioactive Substance Exemption Order for Scotland and Northern Ireland

Any questions?