United Kingdom Nirex Limited

TECHNICAL NOTE

Conventions for the Preparation of the 2007 UK Radioactive Waste Inventory

March 2007
Number: 8157400

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PREFACE

The Department for Environment, Food and Rural Affairs (Defra) and Nuclear Decommissioning Authority (NDA)[1] have commissioned the 2007 UK Radioactive Waste Inventory (2007 Inventory) to provide information on the status of radioactive waste at 1 April 2007 and forecasts of future arisings in the UK. Its aim is to provide comprehensive and up-to-date data in an open and transparent manner for those interested in radioactive waste issues. It is part of an ongoing programme of research jointly conducted by Defra and NDA.

As such, it required the collation of a very large volume of information. As radioactive wastes arise in a diversity of sources and in a large number of different forms, a number of conventions were adopted by Defra and NDA in order to assist the Waste Custodians to prepare the information required for the 2007 Inventory and to ensure that a clear presentation of the information (individual and collective) can be made.

This paper presents the conventions used for the preparation of the 2007 Inventory.

2007 Inventory documents

Information collected for producing the 2007 Inventory is presented in a series of reports, as listed below.

- A summary of the 2007 Inventory;
- The main report for the 2007 Inventory (this document);
- A summary of Information for International Reporting;
- A review of the processes contributing to radioactive wastes in the UK;
- Information on other radioactive substances that may require long-term management as radioactive waste in the UK is presented in a separate report.

These reports are available in both printed and electronic format. Detailed information on the volumes, radioactive, physical and chemical content of the 1269 separate radioactive waste streams reported in the 2007 Inventory is only available in electronic format.

The 2007 Inventory documents can be obtained on CD-ROM from the NDA (see contact details opposite) or via the UK Radioactive Waste Inventory website www.nda.gov.uk/ukinventory.

[1] United Kingdom Nirex Limited (Nirex) managed the preparation of the UK Radioactive Waste Inventory until 1 April 2007, on which date it was integrated with the NDA. As this document was completed before this change, it refers to Nirex. However the preface and conditions of publication have been changed to the generic text used for all 2007 Inventory documents for consistency and to provide up to date contact details to the readers who have queries and feedback on this document and the UK Radioactive Waste Inventory.

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Conditions of Publication

This report is made available under the NDA Transparency Policy. In line with this policy, the NDA is seeking to make information on its activities readily available, and to enable interested parties to have access to and influence on its future programmes. The report may be freely used for non-commercial purposes. However, all commercial uses, including copying and re-publication, require permission from the NDA. All copyright, database rights and other intellectual property rights reside with the NDA. Applications for permission to use the report commercially should be made to the NDA Information Manager.

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Feedback & queries

You are invited to provide feedback to the NDA on the content, clarity and presentation of this report and the UK Radioactive Waste Inventory (i.e. the Inventory). Please do not hesitate to contact the NDA if you have any queries on the Inventory and radioactive waste issues. Such feedback and queries should be addressed to:

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ABSTRACT

United Kingdom Nirex Limited (Nirex) [2], in partnership with the Department for Environment, Food and Rural Affairs (Defra), provides an inventory of radioactive waste for the United Kingdom, i.e. the UK Radioactive Waste Inventory (the Inventory). The Inventory is the most comprehensive and up to date source of information on radioactive waste in the UK in the public domain. As such, it requires the collation of a very large volume of information. As radioactive wastes arise in a diversity of sources and in a large number of different forms, a number of conventions have been adopted by Defra and Nirex in order to assist the Waste Custodians in the preparation of the information that they will provide and to ensure that a clear presentation of the information (individual and collective) can be made.

The current Inventory is the 2004 Inventory and the next update is the planned 2007 Inventory. This paper presents the conventions to be used for the preparation of the 2007 Inventory.

[2] United Kingdom Nirex Limited (Nirex) managed the preparation of the UK Radioactive Waste Inventory until 1 April 2007, on which date it was integrated with the NDA. As this document was completed before this change, it refers to Nirex.

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CONVENTIONS THE PREPARATION OF THE 2007 UK RADIOACTIVE WASTE INVENTORY

Introduction

United Kingdom Nirex Limited (Nirex)[3] prepares and maintains an inventory of radioactive waste in the United Kingdom in conjunction with the Department for Environment, Food and Rural Affairs (Defra), i.e. the UK Radioactive Waste Inventory (the Inventory). The Inventory is the most comprehensive and up to date source of information on radioactive waste in the UK in the public domain.

The preparation of the Inventory requires the collation of a very large volume of information. As radioactive wastes arise in a diversity of sources and in a large number of different forms, a number of conventions have been adopted by Defra and Nirex in order to assist the Waste Custodians in the preparation of the information that they will provide and to ensure that a clear presentation of the information (individual and collective) can be made.

The current Inventory is based on a stock date of 1 April 2004 (i.e. the 2004 Inventory) and the next update is planned to have a stock date of 1 April 2007 (i.e. the 2007 Inventory). In addition to information on characterised UK radioactive waste, the 2007 Inventory will provide, in a separate document, summary information on not fully characterised radioactive wastes and radioactive materials that may become waste.

This paper presents the conventions to be used for the preparation of the 2007 Inventory. Note that conventions for the preparation of information on radioactive materials will be addressed in a separate document.

Generic

1. All information provided by the Waste Custodians for the preparation of the Inventory will be released into the public domain (except for the Work Breakdown Structure codes and interim year volumes). It is the responsibility of the Waste Custodians to ensure that this information is suitable for such a release.
2. The site owner is the organisation responsible for the site where the waste is managed and either manages itself its site and associated waste (i.e. it is also the waste custodian of the waste) or has contracts with waste custodian organisations that manage its sites on its behalf.
3. The waste custodian is the licensee of the site where the waste is currently stored or will arise. The custodian has all responsibilities for the safe and environmental compliant management of the waste.
4. For the 2007 Inventory, the following site owner/waste custodian will be used:
    - The Nuclear Decommissioning Authority (NDA) is a site owner, responsible for the sites managed by the waste custodian organisations: Sellafield Ltd (SL), Magnox Electric Ltd, United Kingdom Atomic Energy Authority (UKAEA)[4], the Low Level Waste Repository Site Licence Company (LLWR SLC) and Springfields Fuels Limited (SFL).
    - The Ministry of Defence (MoD) is a site owner, responsible for the sites managed by Atomic Weapons Establishment (AWE), Babcock, Qinetiq, BAE System Marine Ltd

[3] United Kingdom Nirex Limited (Nirex) managed the preparation of the UK Radioactive Waste Inventory until 1 April 2007, on which date it was integrated with the NDA. As this document was completed before this change, it refers to Nirex.

[4] The Harwell site is owned and operated by UKAEA and leased to NDA who is responsible for all nuclear liabilities on the site (except for those managed by GE healthcare).

(BAESML), Devonport Management Limited (DML) and Rolls Royce Marine Power Operations Ltd (RRMPOL). MoD manages some of its site itself.

- GE Healthcare[5], Urenco and British Energy are both site owner and custodian of wastes managed on their respective sites.
- For waste arising from Minor Waste Producers (WMP), the owner is the WMP and the custodian is the organisation that operates the site where the waste is to be managed.

Waste Streams

5. Radioactive waste is defined in terms of waste streams. A waste stream summarise waste materials or a collection of waste items at a particular site, usually in a particular facility and/or from particular processes or operations. It is often distinguishable by its radionuclide content and in many cases also by its physical and chemical characteristics

6. Each waste stream is allocated a unique identifier. This consists of a digit indicating the waste custodian of the waste, followed by a letter indicating the site of storage, followed by a two- or three-digit number. Numbers in the range 01 to 99 identify operational wastes, and a three-digit number identifies decommissioning wastes. For example:

Waste stream 5B02:	5	(Waste Custodian = UKAEA)
	B	(Site = Dounreay)
	02	(Waste stream = operational)

7. A waste stream that has been conditioned in a suitable container for long-term management, or is being conditioned as it arises, includes a /C suffix (e.g. 2D02/C).

8. Where no data return has been received for a waste stream, and as a result the data in the 2007 Inventory have been derived from existing 2004 Inventory data, the waste stream identifier includes a # suffix (e.g. 9D27#).

9. The minimum information that shall be provided to describe a waste stream is:

   (a) a waste stream identifier;

   (b) a waste stream description;

   (c) a waste category;

   (d) volume(s) (for the waste that exists at the stock date, estimated future arising or both).

10. The volume reported for a waste stream must be greater than zero.

11. Radioactive waste that is not fully characterised (e.g. some contaminated land) will not be included in the 2007 Inventory (except if specifically requested by the Waste Custodian). This waste will however be described in a separate document on UK radioactive materials potentially requiring long-term management as waste. Appendix A provide guidance on how to report liabilities from radioactively contaminated land.

12. The Work Breakdown Structure (WBS) code associated with a waste stream is for local use only and will not be published in the public domain.

[5] Although GE Healthcare facilities at Harwell are located on the UKAEA nuclear licensed site, GE Healthcare has a nuclear site licence for his facility.

Waste Categories

13. The Inventory contains information on High Level Waste (HLW), Intermediate Level Waste (ILW) and Low Level Waste (LLW). These categories are defined in the UK as follows:

    (a) HLW — Wastes in which the temperature may rise significantly as a result of their radioactivity, so this factor has to be taken into account in the design of storage or disposal facilities.

    (b) ILW — Wastes exceeding the upper boundaries for LLW, but which do not require heating to be taken into account in the design of storage or disposal facilities.

    (c) LLW — Wastes containing radioactivity greater than 0.4 MBq per tonne, but not exceeding 4 GBq per tonne of alpha, or 12 GBq per tonne of beta/gamma activity.

14. If a waste stream has specific activities close to the upper limits for LLW and that the Waste Custodian cannot classify the stream definitively, the stream should be designated ILW.

15. ILW streams that will be decay stored or treated, after the stock date, for disposal as LLW must be reported as ILW. Information on the decay storage, treatment and forecast year when the ILW will become LLW should be provided.

16. Other radioactive wastes are not included in the Inventory, i.e. liquid and gaseous discharges to the environment, VLLW from UK non-nuclear licensed sites and Naturally Occurring Radioactive Materials classified as waste.

Disposed Waste

17. If a radioactive waste that was previously reported in the Inventory has been disposed of at the stock date, detailed information on that waste should no longer be reported in the Inventory (i.e. in individual waste stream data). However, information on such waste should be included in the summary information provided on radioactive waste disposed of in the UK by the stock date.

Time of Arising

18. All radioactive waste that exists at the stock date should be included in the Inventory. Information provided on such waste must reflect its quantity, nature and characteristics at the stock date.

19. All radioactive waste that the Waste Custodians forecast to arise after the stock date should also be included in the Inventory. Information provided on such waste must reflect its quantity, nature and characteristics at the time of its arising. This means:

    (a) for wastes originating from routine operations at nuclear facilities, the year it is produced;

    (b) for wastes originating from remediation of contaminated land, the year the land is remediated;

    (c) for wastes originating from decommissioning of nuclear facilities, the year it arises from a decommissioning activity.

20. The volume of future waste arisings should be given for financial years April to March. For simplicity, the financial year April 2011 to March 2012, for example, is referred to as ‘2011’.

Volume

21. For radioactive wastes that exist at the stock date, the volumes reported are those that the wastes occupy in tanks, vaults, drums, etc, in which they are contained at the stock date.

22. For radioactive wastes that the Waste Custodians forecast to arise after the stock date, the volumes reported are those that the wastes will occupy in tanks, vaults, drums, etc, in which they will be contained at the time of their arising.

23. The container should not be included unless it is to be overpacked as part of the waste for long-term management inside another container. For example, for LLW held in ISO container awaiting transport to the LLWR, the volume reported should not include the ISO container.

24. The volume of 200 litre drums containing LLW should be taken as a nominal 200 litres or the assumed volume stated.

25. For waste that has been or will be supercompacted, the waste volume should include the sacrificial containers in which the waste is supercompacted, and any voidage surrounding the resulting pucks where these are packaged in a container for disposal.

26. Volumes of sludges, flocs and other slurry type wastes should include the volume of interstitial fluid, but not the volume of supernate unless this will be part of the conditioned wasteform.

27. For radioactive wastes that are reported in a conditioned form (i.e. waste streams designated with the /C suffix in the stream identifier), the volume reported is the conditioned volume.

28. For an unpackaged waste stream with a corresponding packaged waste stream, negative values can be used to report the annual volumes of the unpackaged waste that are forecast to be packaged (i.e. indicating decreases in the volume of the unpackaged waste). The conditioned waste volume of the resulting packaged waste should be reported for the packaged waste stream. This approach to reporting volumes for wastes that are being retrieved from storage and packaged is encouraged but is not mandatory.

29. The interim year volumes are the actual annual volumes of waste that has arisen between 1 April 2004 and 31 March 2007. BRIMS requires these volumes to decay (if required) a stream radioactive content that was reported in the previous Inventory to the current stock date. If not values if provided for these interim year volumes, BRIMS will derive data using data from the previous Inventory and the updated stock volume. The interim year volumes will not be published in the public domain.

30. Conditioned volume is the volume of the waste form (waste plus immobilising medium) within the container. This should not include any capping material, ullage and disposal container, unless the container is overpacked before disposal, in that case the volume of conditioned waste is the displacement volume of the container.

31. Packaged volume is the displacement volume of the container. It represents a “final” waste volume, whether the waste is stored long-term or disposed.

32. The volumes should be recorded in units of m^3.

Radioactivity

33. The information provided on the radioactivity content of a waste stream is the average specific activity of radionuclides in the waste stream, particularly those radionuclides for which

    - the specific activity is of potential significance for storage, treatment, packaging, transport, disposal or any other reason, whether for normal or accident conditions – see Table 1 for the 112 radionuclides identified as such;

- the specific activity contributes significantly to the total alpha or total beta/gamma activity of the waste stream.

34. The average specific activity reported should be the average activity per unit volume in waste stocks or arisings based on the reported waste volumes. For waste forecast to arise over several years, the annual specific activities should be averaged over the whole arising period.

35. The activities for Other α and Other β/γ are the total activities of all alpha or beta/gamma emitting radionuclides not included in the list of 112 radionuclides – see Table 1.

36. The total α and total β/γ specific activities are the activities of all listed alpha or beta/gamma emitting radionuclides plus Other α or Other β/γ.

37. The activities of short-lived daughter radionuclides should not be included either individually or with the activities of their parent radionuclides or those for Other α and Other β/γ. For the purpose of the Inventory, short-lived means radionuclides with half-lives of less than three months.

38. However, to derive radionuclide activities in all waste that will be reported in the Main Report, the short-lived daughter radionuclides Y-90, Rh-106, Ba-137m and Pr-144 will be assumed to be present in secular equilibrium with their longer-lived parents. This is because these daughter radionuclides contribute significantly to the total radioactivity in all the waste present at the stock date. The following ratios will be used.

	Ratio
Sr-90/Y-90	1:1
Ru-106/Rh-106	1:1
Cs-137/Ba-137m	1:0.946
Ce-144/Pr-144	1:0.982

39. Uncertainty - A double letter Band (e.g. BC) is used to indicate the uncertainty in the average specific activity value. The first letter indicates the limit on the upper (+) side and the second letter indicates the limit on the lower (-) side. These limiting values represent the 5% and 95% levels on the cumulative distributions of activity (i.e. there is a 5% probability of the specific activity being less than the lower limit, and a 95% probability of the activity being less than the upper limit). The uncertainty bands are:

Band A	within a factor of 50%
Band B	within a factor of 3
Band C	within a factor of 10
Band D	within a factor of 100

40. Derivation - A number is used to indicate the derivation of the average specific activity value. The code numbers are as follows:

1	Measured activity
2	Derived activity (best estimate)
3	Derived activity (upper limit)
4	Not present
5	Present but not significant
6	Likely to be present but not assessed
7	Present in significant quantities but not determined
8	Not expected to be present in significant quantities

Do not use Code 4 to indicate that radionuclides are not present when the volume of waste (in either stocks or future arisings) is zero.

41. The specific activity should be recorded in units of TBq/m^3. Two-figure precision is sufficient for activity values.

Physical Properties

42. The physical components known or estimated to make up the waste stream should be reported in terms of % of the waste stream volume or mass.

43. The waste stream volume must be the reported volume, and its mass that derived using its reported volume and density.

44. The % breakdown must add up to 100%.

Chemical Properties

45. The materials components known or estimated to be present in the waste stream should be reported in terms of % of the waste stream volume. Trade names and material grades or standard types should be reported if known.

46. Materials present at less than 1% by weight of the total waste stream mass and that are not significant in terms of waste management issues can be grouped together as 'Others'.

47. The waste stream volume must be the reported volume, and its mass that derived using its reported volume and density.

48. The % breakdown must add up to 100%.

49. For combustible metals, only those that are combustible under temperature and pressure conditions likely to be encountered in storage or after disposal should be included.

50. The % breakdown of metals should only include metals present in elemental form, i.e. not metals present as a constituent of alloys.

51. The % breakdown of inorganic anions should be for the anions only, i.e. not the compound of which the anion is a part.

52. The mean bulk density of a waste stream to be reported should be that of the waste in its form at the stock date or time of arising. If the waste is held in sacrificial containers, the container should be included.

53. If no density is reported for a waste stream it will be assumed to be 1.

54. The density of the conditioned waste to be reported should be the density of the waste form itself - waste plus immobilising material, i.e. not that of the resulting waste package. Unless the container is overpacked before disposal, in that case the density will be that of the resulting waste package.

55. If no conditioned density is reported, a value of 2t/m^3 will be assumed when calculating conditioned weight in the Inventory reports.

Packages

56. The Waste Custodians shall report the number of waste packages that exist at the stock date. This can include complete packages that have or not undergone conditioning. It does not however include containers of LLW awaiting disposal to the LLWR.

57. In addition, the total number of waste packages, conditioned and packaged volumes when all the waste has been packaged will be derived as follows.

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$$\text{Package Number} = \frac{\text{Volume reported}}{\text{Loading}}$$

$$\text{Conditioned Volume} = \text{Volume reported} \times \text{Conditioning Factor}$$

with $$\text{Conditioning Factor} = \frac{\text{Payload}}{\text{Loading}}$$

$$\text{Packaged Volume} = \text{Volume reported} \times \text{Packaging Factor}$$

with $$\text{Packaging Factor} = \frac{\text{Container displacement volume}}{\text{Loading}}$$ (see table below)

Disposal container	**Payload** volume (m^3)	**Displacement** volume (m^3)
LLW		
1/3 height ISO	9.3	13
1/2 height ISO	15.6	19.5
4m box (no shielding)	18.9	20
2m box (no shielding)	9.5	10.2
Standard Nirex ILW		
500l drum	0.47	0.57
500l drum (with pre-cast annulus)	0.4	0.57
500l drum (with basket for waste)	0.47	0.57
$3m^3$ box (round corners)	2.7	3.3
$3m^3$ box (square corners)	2.8	3.6
$3m^3$ drum	2.2	2.6
2m box (no shielding)	9.5	10.2
2m box (with 100mm of concrete shielding)	6.9	10.2
2m box (with 200mm of concrete shielding)	4.9	10.2
2m box (with 300mm of concrete shielding)	3.4	10.2
4m box (no shielding)	18.9	20
4m box (with 100mm of concrete shielding)	14.3	20
4m box (with 200mm of concrete shielding)	10.9	20
4m box (with 300mm of concrete shielding)	8.1	20
Other ILW		
WAGR box	5.76	11.85
MBGWS box	3.5	4.7
Sellafield $3m^3$ box	2.7	3.3
Sellafield enhanced $3m^3$ box	2.15	3.3
HLW		
HLW canister	0.15	0.196

58. If no loading is reported, it will be assumed to be equal to the payload (i.e. equivalent to a conditioning factor of 1.0) when calculating waste package numbers and conditioned or packaged volumes reported in the Inventory reports.

59. If no payload is reported, a representative value will be used when calculating conditioned volumes reported in the Inventory reports (see table above).

60. If no package type is reported for operational ILW streams and Stage 1 decommissioning ILW streams, and if the waste custodian does not advise otherwise, it will be assumed that the waste will be packaged into 500 litres drums. For other decommissioning ILW streams 4m ILW boxes will be used.

61. If no package type is reported for LLW streams, and if the waste custodian does not advise otherwise, it will be assumed that the waste will be packaged into ½ height ISO.

62. For LLW streams that the Waste Custodians forecast to be incinerated in the near future, the packaging and conditioning factors will be assumed to be equal to zero when calculating waste package numbers and conditioned or packaged volumes reported in the Inventory reports, unless otherwise indicated.

Numerical Data

63. The summed waste stream volumes in the Inventory reports will be rounded up to three significant figures.

64. Summed numbers of waste packages will be rounded to three significant figures, except for waste packages at the stock date where the actual numbers being held are reported.

65. Summed waste stream masses and activities will be rounded to two significant figures.

66. All numeric data provided should be given a prefix. The following prefixes are allowed:

Prefix	Interpretation
=	Data supplied by the Data Provider
*	Data provided by the Inventory Contractor and agreed with the Data Provider
**	Data provided by the Inventory Contractor that has been reviewed but not formally endorsed by the Data Provider
<	Less than
<<	Very much less than
>	Greater than
~	Approximately (within a factor of 2)
~~	Very approximately (within a factor of 10)
P	Present but not quantified (in general, this will be >100ppm). For use in physical and chemical description only.
TR	Present at trace levels (in general, this will be in the range 1-100ppm) For use in physical and chemical description only.
NE	Not estimated or data not available

Table 1 – 112 significant radionuclides

Radionuclide	Half-life (years)	Main decay mode
H-3	1.23E+01	βγ
Be-10	1.60E+06	βγ
C-14	5.73E+03	βγ
Cl-36	3.02E+05	βγ
Ar-39	2.69E+02	βγ
Ar-42	3.30E+01	βγ
K-40	1.28E+09	βγ
Ca-41	1.03E+05	βγ
Mn-53	3.70E+06	βγ
Mn-54	8.56E-01	βγ
Fe-55	2.70E+00	βγ
Co-60	5.27E+00	βγ
Ni-59	7.49E+04	βγ
Ni-63	1.00E+02	βγ
Zn-65	6.69E-01	βγ
Se-79	6.50E+04	βγ
Kr-81	2.10E+05	βγ
Kr-85	1.07E+01	βγ
Rb-87	4.80E+10	βγ
Sr-90	2.91E+01	βγ
Zr-93	1.53E+06	βγ
Nb-91	6.80E+02	βγ
Nb-92	3.50E+07	βγ
Nb-93m	1.64E+01	βγ
Nb-94	2.03E+04	βγ
Mo-93	3.50E+03	βγ
Tc-97	2.60E+06	βγ
Tc-99	2.13E+05	βγ
Ru-106	1.01E+00	βγ
Pd-107	6.50E+06	βγ
Ag-108m	4.18E+02	βγ
Ag-110m	6.84E-01	βγ
Cd-109	1.27E+00	βγ
Cd-113m	1.41E+01	βγ
Sn-119m	8.02E-01	βγ
Sn-121m	5.00E+01	βγ
Sn-123	3.54E-01	βγ
Sn-126	1.00E+05	βγ
Sb-125	2.73E+00	βγ
Sb-126	3.39E-02	βγ
Te-125m	1.59E-01	βγ
Te-127m	2.98E-01	βγ
I-129	1.57E+07	βγ
Cs-134	2.06E+00	βγ
Cs-135	2.30E+06	βγ
Cs-137	3.00E+01	βγ
Ba-133	1.05E+01	βγ
La-137	6.00E+04	βγ
La-138	1.05E+11	βγ
Ce-144	7.80E-01	βγ
Pm-145	1.77E+01	βγ

Radionuclide	Half-life (years)	Main decay mode
Pm-147	2.62E+00	βγ
Sm-147	1.06E+11	α
Sm-151	8.87E+01	βγ
Eu-152	1.33E+01	βγ
Eu-154	8.60E+00	βγ
Eu-155	4.96E+00	βγ
Gd-153	6.61E-01	βγ
Ho-163	4.57E+03	βγ
Ho-166m	1.20E+03	βγ
Tm-170	3.52E-01	βγ
Tm-171	1.92E+00	βγ
Lu-174	3.31E+00	βγ
Lu-176	3.61E+10	βγ
Hf-178n	3.10E+01	βγ
Hf-182	8.99E+06	βγ
Pt-193	5.07E+01	βγ
Tl-204	3.78E+00	βγ
Pb-205	1.52E+07	βγ
Pb-210	2.23E+01	βγ
Bi-208	3.68E+05	βγ
Bi-210m	3.00E+06	α
Po-210	3.79E-01	α
Ra-223	3.13E-02	α
Ra-225	4.08E-02	βγ
Ra-226	1.60E+03	α
Ra-228	5.75E+00	βγ
Ac-227	2.18E+01	βγ
Th-227	5.12E-02	α
Th-228	1.91E+00	α
Th-229	7.34E+03	α
Th-230	7.54E+04	α
Th-232	1.41E+10	α
Th-234	6.60E-02	βγ
Pa-231	3.28E+04	α
Pa-233	7.39E-02	βγ
U-232	6.98E+01	α
U-233	1.59E+05	α
U-234	2.46E+05	α
U-235	7.04E+08	α
U-236	2.34E+07	α
U-238	4.47E+09	α
Np-237	2.14E+06	α
Pu-236	2.90E+00	α
Pu-238	8.77E+01	α
Pu-239	2.41E+04	α
Pu-240	6.56E+03	α
Pu-241	1.44E+01	βγ
Pu-242	3.74E+05	α
Am-241	4.33E+02	α
Am242m	1.41E+02	βγ
Am-243	7.36E+03	α
Cm-242	4.46E-01	α
Cm-243	3.00E+01	α

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Radionuclide	Half-life (years)	Main decay mode
Cm-244	1.81E+01	α
Cm-245	8.50E+03	α
Cm-246	4.73E+03	α
Cm-248	3.40E+05	α
Cf-249	3.51E+02	α
Cf-250	1.31E+01	α
Cf-251	8.98E+02	α
Cf-252	2.65E+00	α

Reference: The identification of radionuclides relevant to long-term waste management in the United Kingdom, Nirex, November 2004, Nirex Report N/105.

TECHNICAL NOTE

APPENDIX A – GUIDANCE FOR REPORTING LIABILITIES FROM RADIOACTIVELY CONTAMINATED LAND

Some licensed sites have identified areas of radioactively contaminated land. Most radioactively contaminated land is of low activity, and can be categorised as shown in the table on the right. These categories are based on the Radioactive Substances Act 1993 and its Exemption Orders (RSA93) and the categorisation developed by the Nuclear Decommissioning Authority. Note that the Government is currently reviewing the LLW categorisation.

The 2007 Inventory must include information on all radioactively contaminated land, except for Very Low Level Waste (VLLW), Substances of Low Activity (SoLA) and liquid or gaseous discharges to the environment that may arise from the remediation of such land, as well as waste that has already arisen from such activities and has been disposed of.

Where areas of radioactively contaminated land are well characterised and there is reasonable certainty on the liability volume, information should be reported in the Radioactive Waste Inventory. This information will be collected using this Inventory Questionnaire and released in the public domain in a similar format as for the 2004 Inventory.

Where there is large uncertainty or characterisation programmes have yet to commence, information on radioactively contaminated land should be reported in the Radioactive Material Inventory. The Inventory Support Contractor will collect this information off-line (via references available in the public domain and the waste custodians). It will be reported in the new 2007 Inventory report on radioactive substances that may potentially require long term management as radioactive waste in the future.

Categories of low activity waste Note 1	**Activity level**
Low Level Waste 1 (LLW1)	Alpha activity > 1 Bq/g but ≤ 4 kBq/g Beta/gamma activity > 40 Bq/g but ≤ 12 kBq/g
Volume Low Level Waste 2 (LLW2)	Total activity > 0.4 Bq/g Alpha activity ≤ 1 Bq/g Beta/gamma activity ≤ 40 Bq/g
High Volume (HV) LLW2 Note 2	Volume > 100m^3.
Low Volume (LV) LLW2	Volume ≤ 100m^3
Very Low Level Waste (VLLW) Note 3	Alpha activity ≤ RSA93 levels Note 4 Beta/gamma activity ≤ 400 kBq per 0.1 m^3 of material *and* with no individual item > 40 kBq Note 5
High Volume (HV) LLW2	Volume > 0.1m^3.
Low Volume (LV) LLW2	Volume ≤ 0.1m^3
Substances of Low Activity (SoLA) Note 6	Total man-made activity ≤ 0.4 Bq/g Note 7

Notes

1. To quantify LLW in this way does not predetermine the selection of appropriate management option(s), except for VLLW and SoLA (see notes 2, 3 and 6).
2. HV LLW2 is waste that cannot be disposed of with ordinary refuse to landfill sites or municipal waste incinerators.
3. VLLW is routinely disposed of with ordinary refuse to landfill sites or municipal waste incinerators. This disposal requires an authorisation from the Environment Agency. VLLW generally originates from non-nuclear sites in small quantities, i.e. dust-bin VLLW. However some small nuclear sites may be granted authorisations to dispose of VLLW in larger quantities, i.e. high volume VLLW.

4. Authorisations may be exceptionally granted allowing up to 10% of the standard amounts of alpha emitting radionuclides artificially formed (i.e. 40 kBq per in any 0.1 m^3, 4 kBq per item).
5. This condition may be relaxed by up to an order of magnitude (i.e. 4 MBq in any 0.1 m^3, 400 kBq per item) where the radioactivity arises solely from tritium and/or carbon 14.
6. SoLA is exempt from specific regulatory control, other than that specified in the SoLA Exemption Order of RSA93. This waste is usually disposed to landfill sites or municipal waste incinerators.
7. For waste that is substantially insoluble in water.

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