

WASTE STREAM	2C931	LLW Radioactive Sources
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SITE Chapelcross
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	<< 0.1 m ³
Total future arisings:		0 m ³
Total waste volume:		<< 0.1 m ³
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper): x 1.2	Arisings (upper) x
	Stock (lower): x 0.8	Arisings (lower) x

WASTE SOURCE Sealed radioactive sources which were used for applications such as calibration of equipment, instrument testing etc.

PHYSICAL CHARACTERISTICS

General description: The sources are made from a mixture of materials including: impregnated fabric, plastic, perspex, metal, resin beads and wood. All 73 sources have been grouted into a single 11 litre container with a approximately 10 litres of grout - a minimum of 100 ml of grout surrounding each source.

Physical components (%vol): -

Sealed sources: The waste contains sealed sources. 73

Bulk density (t/m³): ~5

Comment on density: Calculated by dividing waste stream mass by volume.

CHEMICAL COMPOSITION

General description and components (%wt): Metal: 3% (consisting of 50:50 Aluminium and Mild Steel) Concrete / Cementitious material: 93%, Wood: 2%, non-halogenated plastics: 1% and Other: 1% (Others consists of sources in the form of pellets.)

Chemical state: Neutral

Chemical form of radionuclides: -

Metals and alloys (%wt): -

Stainless steel.....		
Other ferrous metals.....	1.5	Mild steel
Iron.....		
Aluminium.....	1.5	
Beryllium.....		
Cobalt.....		
Copper.....		
Lead.....		
Magnox/Magnesium.....		
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....		
Zircaloy/Zirconium.....		
Other metals.....		

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Organics (%wt):

-
Total cellulose..... 2.0
Paper, cotton.....
Wood..... 2.0
Halogenated plastics
Total non-halogenated plastics..... 1.0
Condensation polymers.....
Others..... 1.0
Organic ion exchange materials....
Total rubber..... 0
Halogenated rubber
Non-halogenated rubber.....
Hydrocarbons.....
Oil or grease
Fuel.....
Asphalt/Tarmac (cont.coal tar)...
Asphalt/Tarmac (no coal tar)....
Bitumen.....
Others.....
Other organics.....

Other materials (%wt):

-
Inorganic ion exchange materials.
Inorganic sludges and flocs.....
Soil.....
Brick/Stone/Rubble.....
Cementitious material..... 93.0
Sand.....
Glass/Ceramics.....
Graphite.....
Desiccants/Catalysts.....
Asbestos.....
Non/low friable.....
Moderately friable.....
Highly friable.....
Free aqueous liquids.....
Free non-aqueous liquids.....
Powder/Ash.....

Inorganic anions (%wt):

-

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Fluoride.....
 Chloride.....
 Iodide.....
 Cyanide.....
 Carbonate.....
 Nitrate.....
 Nitrite.....
 Phosphate.....
 Sulphate.....
 Sulphide.....

Materials of interest for
 waste acceptance criteria:

-
 Combustible metals.....
 Low flash point liquids.....
 Explosive materials.....
 Phosphorus.....
 Hydrides.....
 Biological etc. materials.....
 Biodegradable materials.....
 Putrescible wastes.....
 Non-putrescible wastes.....
 Corrosive materials.....
 Pyrophoric materials.....
 Generating toxic gases.....
 Reacting with water.....
 Active particles.....
 Soluble solids as bulk chemical
 compounds.....

Hazardous substances /
 non hazardous pollutants:

-
 Acrylamide.....
 Benzene.....
 Chlorinated solvents.....
 Formaldehyde.....
 Organometallics.....
 Phenol.....
 Styrene.....
 Tri-butyl phosphate.....
 Other organophosphates.....
 Vinyl chloride.....
 Arsenic.....
 Barium.....
 Boron.....

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- Cadmium.....
- Caesium.....
- Selenium.....
- Chromium.....
- Molybdenum.....
- Thallium.....
- Tin.....
- Vanadium.....
- Mercury compounds.....
- Others.....
- Electronic Electrical Equipment (EEE)
 - EEE Type 1.....
 - EEE Type 2.....
 - EEE Type 3.....
 - EEE Type 4.....
 - EEE Type 5.....

Complexing agents (%wt):

- EDTA.....
- DPTA.....
- NTA.....
- Polycarboxylic acids.....
- Other organic complexants.....
- Total complexing agents.....

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None		100.0

Comment on planned treatments:

As much extraneous packaging and shielding has been removed from the sources as possible prior to packaging in a single small container. All 73 sources have been grouted into a single 11 litre container with a approximately 10 litres of grout - a minimum of 100 ml of grout surrounding each source.

WASTE STREAM**2C931****LLW Radioactive Sources****Disposal Routes:**

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known	100.0

Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known			

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m ³	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	100.0	15.5	< 1

Other information: Due to small volume of waste, likely to be co-disposed with other streams.

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste has a current WCH.

Waste consigned for disposal to LLWR in year of generation: -

Potential for the waste to contain discrete items: -

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

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Source:	-
Uncertainty:	-
Definition of total alpha and total beta/gamma:	Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.
Measurement of radioactivities:	A programme of measurements was undertaken to derive the best estimate of the source activity. Therefore the activity of each source is known. Details taken from Chapelcross redundant sources inventory – Estimation of source activity, 102280/TR/0001, Issue 2, February 2013.
Other information:	-

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LLW Radioactive Sources

Nuclide	Mean radioactivity, TBq/m ³			Nuclide	Mean radioactivity, TBq/m ³		
	Waste at 1.4.2019	Bands and Code	Future arisings		Waste at 1.4.2019	Bands and Code	Future arisings
H 3	9.56E-05	BB 2		Gd 153		8	
Be 10		8		Ho 163		8	
C 14	4.2E-05	BB 2		Ho 166m		8	
Na 22		8		Tm 170		8	
Al 26		8		Tm 171		8	
Cl 36	1E-06	BB 2		Lu 174		8	
Ar 39		8		Lu 176		8	
Ar 42		8		Hf 178n		8	
K 40		8		Hf 182		8	
Ca 41		8		Pt 193		8	
Mn 53		8		Tl 204		8	
Mn 54		8		Pb 205		8	
Fe 55		8		Pb 210	8.02E-06	BB 2	
Co 60	7.69E-07	BB 2		Bi 208		8	
Ni 59		8		Bi 210m		8	
Ni 63		8		Po 210	5.9E-06	BB 2	
Zn 65		8		Ra 223		8	
Se 79		8		Ra 225		8	
Kr 81		8		Ra 226	1.35E-04	BB 2	
Kr 85		8		Ra 228	2.14E-07	BB 2	
Rb 87		8		Ac 227		8	
Sr 90	1.62E-05	BB 2		Th 227		8	
Zr 93		8		Th 228	6.4E-08	BB 2	
Nb 91		8		Th 229		8	
Nb 92		8		Th 230		8	
Nb 93m		8		Th 232	1E-06	BB 2	
Nb 94		8		Th 234	3.9E-05	BB 2	
Mo 93		8		Pa 231		8	
Tc 97		8		Pa 233		8	
Tc 99	1E-06	BB 2		U 232		8	
Ru 106		8		U 233		8	
Pd 107		8		U 234	3.9E-05	BB 2	
Ag 108m		8		U 235	2E-06	BB 2	
Ag 110m		8		U 236		8	
Cd 109		8		U 238	3.9E-05	BB 2	
Cd 113m		8		Np 237		8	
Sn 119m		8		Pu 236		8	
Sn 121m		8		Pu 238		8	
Sn 123		8		Pu 239	1E-06	BB 2	
Sn 126		8		Pu 240		8	
Sb 125		8		Pu 241		8	
Sb 126		8		Pu 242		8	
Te 125m		8		Am 241	1.16E-04	BB 2	
Te 127m		8		Am 242m		8	
I 129		8		Am 243		8	
Cs 134		8		Cm 242		8	
Cs 135		8		Cm 243		8	
Cs 137	2.2E-07	BB 2		Cm 244		8	
Ba 133	1.75E-06	BB 2		Cm 245		8	
La 137		8		Cm 246		8	
La 138		8		Cm 248		8	
Ce 144		8		Cf 249		8	
Pm 145		8		Cf 250		8	
Pm 147		8		Cf 251		8	
Sm 147		8		Cf 252		8	
Sm 151		8		Other a			
Eu 152		8		Other b/g			
Eu 154		8		Total a	3.39E-04	BB 2	0
Eu 155		8		Total b/g	2.06E-04	BB 2	0

Bands (Upper and Lower)

- A a factor of 1.5
- B a factor of 3
- C a factor of 10
- D a factor of 100
- E a factor of 1000

Note: Bands quantify uncertainty in mean radioactivity.

Code

- 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 quantity