

WASTE STREAM**5C08****ILW Concrete Lined Drums**

SITE Harwell
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW; PFSD

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	434.4 m ³
Total future arisings:		0 m ³
Total waste volume:		434.4 m ³
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper): x 1.05	Arisings (upper) x
	Stock (lower): x 0.95	Arisings (lower) x

WASTE SOURCE Wastes from various sites which were packaged for the abandoned 1982 sea disposal campaigns.

PHYSICAL CHARACTERISTICS

General description: Miscellaneous radioactive wastes held in mild steel drums within a concrete carcass. Internal packages contain absorbed liquid, precipitated sludge, incinerator ash, and laboratory trash. Type 1801 sea disposal drums contain an internal drum of 100 litres in an external drum of 200 litres and weigh up to 352 kg. Type 1802 sea disposal drums contain an internal drum of 200 litres in an external drum of 450 litres and weigh up to 1060 kg (one drum is 5890 kg). Type 1803 sea disposal drums contain various inner drums from 10 litres to 200 litres in an external drum of 630 litres and weigh up to 2290 kg.

Physical components (%wt): Mild steel outer drums ~8%, inactive concrete carcasses ~38%, waste (including cemented wastes and inner cans/ liners) ~54%.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.77

Comment on density: Total mass divided by total volume.

CHEMICAL COMPOSITION

General description and components (%wt): The waste consists of metals, glass, plastics, paper, sludges, ash etc. in mild steel drums within a concrete carcass. Concrete/ cemented wastes (37%), ferrous metals (24%), Al (7%), other metals including sources (9%), plastics (4%), cellulose (2%), balance others.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Some tritiated D2O is present, remainder from activation of metals
C-14: Small proportion as labelled organic compounds. Bulk as activation product.
Cl-36: From activation of impurities in metals
I-129: From fission products
Ra: Some Ra and Ra/Be sources, remainder within fuel contamination.
Th: Bulk thorium metal and thorium oxide
U: Principally as bulk metal, with some as irradiated metal/ oxide fuel
Pu: Probably principally as oxide or metal fuel

Metals and alloys (%wt): The thickness of the drum skins and cans within is ~3mm. The form of metals within the wastes varies. Uranium can be present as single items up to 50kg.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~8.0	Grades of stainless are generally unknown, and in many cases only "metal" is declared; taken to be mild steel. A proportion of the waste (~4%) consists of sources. The mass of these is assumed to be dominated by stainless. Other alloys may also be present, but none	

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Other ferrous metals.....	~20.0	specifically declared. Ferrous metals consist principally of mild steel; small amounts of cast iron are also present.
Iron.....		
Aluminium.....	~7.0	
Beryllium.....	TR	
Cobalt.....		
Copper.....	<0.10	
Lead.....	<4.0	
Magnox/Magnesium.....	TR	
Nickel.....		
Titanium.....		
Uranium.....	~0.70	
Zinc.....	TR	
Zircaloy/Zirconium.....	TR	
Other metals.....	~0.73	Other metals principally U & Th. Also small amounts of cobalt, cadmium, titanium, tungsten, and beryllium; traces of scandium, tantalum, iridioplatinum, palladium.

Organics (%wt):

The waste contains cellulose, halogenated plastic, non-halogenated plastic, halogenated rubber and non-halogenated rubber. There are only traces of organic ion exchange resin from Harwell MTRs. The waste also contains traces of pharmaceutical compounds and other organics, small amounts of perspex and other plastics.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	~2.1		
Paper, cotton.....	~2.0		
Wood.....	<0.10		
Halogenated plastics	~2.0	Halogenated plastic is principally PVC, though PTFE may also be present.	
Total non-halogenated plastics.....	~2.0		
Condensation polymers.....	TR		
Others.....	~2.0	The non-halogenated plastic is principally polythene.	
Organic ion exchange materials....	TR		
Total rubber.....	~0.10		
Halogenated rubber	~0.10	Rubbers are expected to comprise neoprene and hypalon.	
Non-halogenated rubber.....	TR		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			

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Other organics..... TR

Other materials (%wt): The percentage sludges and flocs includes cemented sludges; it is not always clear from records whether these have been cemented or merely dried. A small number of drums contain only clinoptilolite. Assumed remaining mass is due to grout encapsulant.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	~0.10		
Inorganic sludges and flocs.....	<7.0		
Soil.....	0		
Brick/Stone/Rubble.....	TR		
Cementitious material.....	45.4		
Sand.....			
Glass/Ceramics.....	~1.0		
Graphite.....	<0.10		
Desiccants/Catalysts.....			
Asbestos.....	TR		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	TR		
Free non-aqueous liquids.....	TR		
Powder/Ash.....	P		

Inorganic anions (%wt): Carbonate and sulphate are present in the cement matrices only. Four drums contain fire suppressant Eutectic chloride powders, likely to be in kg amounts.. Single drums only contain trace amounts of HF, oxalic acid, HNO3, U arsenide, carbide & selenide. MoD monoliths contain cemented decontamination reagent (permanate with EDTA+ citrate) the precise composition of which is unknown.

	(%wt)	Type(s) and comment
Fluoride.....	TR	
Chloride.....	TR	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	P	
Nitrate.....	TR	
Nitrite.....	0	
Phosphate.....	0	
Sulphate.....	P	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: Potentially combustible metals include uranium and zircaloy. However, there is no evidence that significant amounts are present in finely-divided forms. All liquids except trace amounts should be on absorbents. Powders will be present from degradation of plastics and cellulose and corrosion of metals in addition to the initial waste: floor sweepings, chemicals etc (<1%), incinerator ash ~1%.

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	(%wt)	Type(s) and comment
Combustible metals.....	TR	
Low flash point liquids.....	TR	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....		
Corrosive materials.....	TR	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances /
non hazardous pollutants:

The waste contains small amounts of barium chloride, cadmium, uranium and beryllium.
Lead is also present as bulk metal.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
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): Yes

(%wt) Type(s) and comment

EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....

Trace oxalic acid in one drum. MoD monoliths contain cemented decontamination reagent (permanate with EDTA+ citrate) the precise composition of which is unknown. These drums represent <7% of the total stream mass, most of which will be cement.

Total complexing agents..... TR

Potential for the waste to contain discrete items: Yes. Grouted drums are considered to be DIs

PACKAGING AND CONDITIONING

Conditioning method: The CLDs will be overpacked into either TN Gemini or Full Height ISOs for transfer to Sellafield where they will receive final treatment in preparation for long term storage at GDF.

Plant Name: -
 Location: -
 Plant startup date: -
 Total capacity (m³/y incoming waste): -
 Target start date for packaging this stream: -
 Throughput for this stream (m³/y incoming waste): -
 Other information: -

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages

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Likely container type comment: -

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: PFA/OPC and None
 Other information: Expected to use 3:1 PFA 0.42 w/s as developed for Harwell RHILW.

Conditioned density (t/m³): ~1.8
 Conditioned density comment: The density will vary with the combination of drums within each package.

Other information on conditioning: -

Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

RADIOACTIVITY

Source: Predominantly contamination from fuel handling facilities. Also some activated items from MTR operations and sealed sources and bulk uranium from small users' facilities.

Uncertainty: Data was completely revised in RWI 2013 as a result of a thorough review of original information and application of waste fingerprints. The accuracy has, therefore, been improved but still depends upon the accuracy of the original declarations. Activity updated for the 2019 UKRWI.

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: Fingerprints have been applied to original consignors' declarations. These declarations were often based upon gamma measurements, with some neutron counting.

Other information: -

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	1.39E-01	BB 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	2.54E-05	BB 2			Ho 166m		8		
Na 22	3.46E-08	BB 2			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	9.57E-05	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	1.43E-07	BB 2		
Mn 54		8			Pb 205		8		
Fe 55	1.08E-07	BB 2			Pb 210	4.60E-05	BB 2		
Co 60	4.17E-06	BB 2			Bi 208		8		
Ni 59	9.6E-07	BB 2			Bi 210m		8		
Ni 63	7.53E-04	BB 2			Po 210	3.78E-05	BB 2		
Zn 65		8			Ra 223	1.25E-05	BB 2		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226	5.23E-04	BB 2		
Kr 85	3.38E-05	BB 2			Ra 228	1.37E-07	BB 2		
Rb 87		8			Ac 227	1.25E-05	BB 2		
Sr 90	1.92E-03	BB 2			Th 227	1.23E-05	BB 2		
Zr 93		8			Th 228	1E-07	BB 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	2.07E-09	BB 2		
Nb 93m	2.89E-07	BB 2			Th 232	1.4E-07	BB 2		
Nb 94	1.09E-07	BB 2			Th 234	4.48E-06	BB 2		
Mo 93	1.91E-08	BB 2			Pa 231	1.62E-05	BB 2		
Tc 97		8			Pa 233	2.43E-05	BB 2		
Tc 99	4.27E-06	BB 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	7.50E-05	BB 2		
Ag 108m		8			U 235	4.47E-07	BB 2		
Ag 110m		8			U 236	4.60E-07	BB 2		
Cd 109		8			U 238	4.48E-06	BB 2		
Cd 113m		8			Np 237	2.43E-05	BB 2		
Sn 119m		8			Pu 236		8		
Sn 121m	2.33E-07	BB 2			Pu 238	1.32E-02	BB 2		
Sn 123		8			Pu 239	4.34E-02	BB 2		
Sn 126		8			Pu 240	2.96E-02	BB 2		
Sb 125	3.61E-09	BB 2			Pu 241	6.29E-01	BB 2		
Sb 126		8			Pu 242	1.72E-05	BB 2		
Te 125m		8			Am 241	9.90E-02	BB 2		
Te 127m		8			Am 242m	3.87E-06	BB 2		
I 129		8			Am 243	9.37E-06	BB 2		
Cs 134	1.39E-09	BB 2			Cm 242	3.16E-06	BB 2		
Cs 135		8			Cm 243	1.62E-06	BB 2		
Cs 137	7.27E-02	BB 2			Cm 244	9.18E-05	BB 2		
Ba 133		8			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	7.74E-08	BB 2			Cf 251		8		
Sm 147		8			Cf 252	7.84E-09	BB 2		
Sm 151	5.03E-06	BB 2			Other a				
Eu 152	1.72E-08	BB 2			Other b/g				
Eu 154	2.66E-06	BB 2			Total a	1.86E-01	BB 2	0	
Eu 155	7.75E-08	BB 2			Total b/g	8.43E-01	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