

<b>WASTE STREAM</b>	<b>5C333</b>	<b>Harwell Care &amp; Maintenance LLW</b>
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**SITE** Harwell  
**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** LLW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	0.6 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2027.....	~1.4 m <sup>3</sup>
Total future arisings:		1.4 m <sup>3</sup>
Total waste volume:		2.0 m <sup>3</sup>
Comment on volumes:	Arisings dependent on future C&M programme. Arisings from future C&M operations have been estimated based on other Magnox sites.	
Uncertainty factors on volumes:	Stock (upper): x 1.5	Arisings (upper) x 1.5
	Stock (lower): x 0.5	Arisings (lower) x 0.5

**WASTE SOURCE** Secondary wastes associated with C&M operations.

**PHYSICAL CHARACTERISTICS**

General description: Uncompacted waste in 200 litre drums.  
 Physical components (%vol): Approximate estimate - Metals 35%; Organics 42.6%; Other (Soil/Rubble/Concrete/Glass/Plastic/Rubber) 22.4%.  
 Sealed sources: The waste does not contain sealed sources.  
 Bulk density (t/m<sup>3</sup>): 0.25  
 Comment on density: -

**CHEMICAL COMPOSITION**

General description and components (%wt): Approximate densities have been assumed based on likely makeup of waste.  
 Chemical state: Neutral  
 Chemical form of radionuclides: H-3: Unknown.  
 C-14: Unknown.  
 Cl-36: Probably chlorides  
 I-129: Probably iodides  
 Ra: Unknown.  
 Th: Probably metal, oxide or nitrate.  
 U: Probably metal, oxide or nitrate.  
 Np: Expected to be either oxide or nitrate.  
 Pu: Probably metal, oxide or nitrate.  
 Metals and alloys (%wt): Not known. Typically small items.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~20.0		
Other ferrous metals.....	~6.0		
Iron.....			
Aluminium.....	~0.30		
Beryllium.....	NE		
Cobalt.....			
Copper.....	~4.5		
Lead.....	<4.2		

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Magnox/Magnesium.....	NE	
Nickel.....		
Titanium.....		
Uranium.....	NE	
Zinc.....	TR	
Zircaloy/Zirconium.....	NE	
Other metals.....	TR	Other unspecified metals assumed largely to be other ferrous based or stainless steel alloys.

Organics (%wt):	Miscellaneous organic liquid is listed, <0.2%.		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~4.9		
Paper, cotton.....	~4.7		
Wood.....	~0.20		
Halogenated plastics .....	~34.7	All unidentified plastic is assumed to be halogenated plastic (e.g. PVC).	
Total non-halogenated plastics.....	~2.8		
Condensation polymers.....	<1.4		
Others.....	<1.4		
Organic ion exchange materials....	0		
Total rubber.....	~0.20		
Halogenated rubber .....	<0.20		
Non-halogenated rubber.....	TR		
Hydrocarbons.....			
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	TR		

Other materials (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	10.0		
Brick/Stone/Rubble.....	10.0		
Cementitious material.....	<1.2		
Sand.....			
Glass/Ceramics.....	<1.2		
Graphite.....	0		
Desiccants/Catalysts.....			

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Asbestos.....	0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	TR
Powder/Ash.....	~0.10

Inorganic anions (%wt):       N/A

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

Materials of interest for waste acceptance criteria:       Waste may contain low levels of powdery contamination (e.g from Hoover bags).

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....		
Corrosive materials.....	0	
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:       A quantity of lead is present (~4.2%).

	(%wt)	Type(s) and comment
Acrylamide.....		

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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):

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	NE	

Potential for the waste to contain discrete items:      Not yet determined. In & of itself not a DI; waste stream may include DIs (notably any stainless steel components)

**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:

-

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
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	0.25

Classification codes for waste expected to be consigned to a landfill facility:

-

**Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):**

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
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			

**Opportunities for alternative disposal routing:**

-

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

**Waste Packaging for Disposal:**

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Container	Stream volume %	Waste loading m <sup>3</sup>	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	~10	< 1

Other information: -

**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 does not have a current WCH.

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

**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**

Source:      Principally contamination from a range of operations.

Uncertainty:      The fingerprint for future C&M operations is not likely to be significantly different from past wastes, and will be derived for wastes as appropriate.

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 are confirmed for individual operations using direct and indirect monitoring processes allied to specific analyses and historical knowledge.

Other information: -

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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		8		8	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	2.94E-09	BB 2	2.94E-09	BB 2	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36		8		8	Lu 174		8		8
Ar 39		8		8	Lu 176		8		8
Ar 42		8		8	Hf 178n		8		8
K 40		8		8	Hf 182		8		8
Ca 41		8		8	Pt 193		8		8
Mn 53		8		8	Tl 204		8		8
Mn 54		8		8	Pb 205		8		8
Fe 55		8		8	Pb 210		8		8
Co 60		8		8	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63		8		8	Po 210		8		8
Zn 65		8		8	Ra 223		8		8
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226		8		8
Kr 85		8		8	Ra 228		8		8
Rb 87		8		8	Ac 227		8		8
Sr 90	3.73E-08	BB 2	3.73E-08	BB 2	Th 227		8		8
Zr 93		8		8	Th 228		8		8
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230		8		8
Nb 93m		8		8	Th 232		8		8
Nb 94		8		8	Th 234		8		8
Mo 93		8		8	Pa 231		8		8
Tc 97		8		8	Pa 233		8		8
Tc 99		8		8	U 232		8		8
Ru 106		8		8	U 233		8		8
Pd 107		8		8	U 234		8		8
Ag 108m		8		8	U 235		8		8
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238		8		8
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	2.26E-07	BB 2	2.26E-07	BB 2
Sn 123		8		8	Pu 239	1.1E-06	BB 2	1.1E-06	BB 2
Sn 126		8		8	Pu 240	1.08E-06	BB 2	1.08E-06	BB 2
Sb 125		8		8	Pu 241	2.55E-05	BB 2	2.55E-05	BB 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	3.89E-06	BB 2	3.89E-06	BB 2
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134		8		8	Cm 242		8		8
Cs 135		8		8	Cm 243		8		8
Cs 137	1.47E-07	BB 2	1.47E-07	BB 2	Cm 244	1.55E-09	BB 2	1.55E-09	BB 2
Ba 133		8		8	Cm 245		8		8
La 137		8		8	Cm 246		8		8
La 138		8		8	Cm 248		8		8
Ce 144		8		8	Cf 249		8		8
Pm 145		8		8	Cf 250		8		8
Pm 147		8		8	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151		8		8	Other a				
Eu 152		8		8	Other b/g				
Eu 154		8		8	<b>Total a</b>	<b>6.30E-06</b>	<b>BB 2</b>	<b>6.30E-06</b>	<b>BB 2</b>
Eu 155		8		8	<b>Total b/g</b>	<b>2.57E-05</b>	<b>BB 2</b>	<b>2.57E-05</b>	<b>BB 2</b>

**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