

<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

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0.4 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2027.....	~1.6 m <sup>3</sup>
Total future arisings:		1.6 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: -  
 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.  
 Stainless steel..... ~20.0  
 Other ferrous metals..... ~6.0  
 Iron.....  
 Aluminium..... ~0.30  
 Beryllium..... NE  
 Cobalt.....  
 Copper..... ~4.5  
 Lead..... <4.2  
 Magnox/Magnesium..... NE  
 Nickel.....  
 Titanium.....  
 Uranium..... NE

**WASTE STREAM**

**5C333 Harwell Care & Maintenance LLW**

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%.  
 Total cellulosics..... ~4.9  
     Paper, cotton..... ~4.7  
     Wood..... ~0.20  
 Halogenated plastics ..... ~34.7  
 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

All unidentified plastic is assumed to be halogenated plastic (e.g. PVC).

Other materials (%wt):

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

**WASTE STREAM****5C333****Harwell Care & Maintenance LLW**

Inorganic anions (%wt):

N/A	
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).

Combustible metals.....	0
Low flash point liquids.....	0
Explosive materials.....	0
Phosphorus.....	0
Hydrides.....	0
Biological etc. materials.....	0
Biodegradable materials.....	
Putrescible wastes.....	0
Non-putrescible wastes.....	
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Active particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances / non hazardous pollutants:

A quantity of lead is present (~4.2%).

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

**WASTE STREAM****5C333****Harwell Care & Maintenance LLW**

Boron.....  
 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..... NE

**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:

-

**WASTE STREAM****5C333****Harwell Care & Maintenance LLW****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 <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.

The WSCD covers current arisings only. This will have to be reviewed and potentially revised to cover new operations.

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**

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:	-

**WASTE STREAM**

**5C333**

**Harwell Care & Maintenance LLW**

Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	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	4.01E-08	BB 2	4.01E-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	2.31E-07	BB 2	2.31E-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	2.94E-05	BB 2	2.94E-05	BB 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	3.78E-06	BB 2	3.78E-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	1.57E-07	BB 2	1.57E-07	BB 2	Cm 244	1.74E-09	BB 2	1.74E-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>6.19E-06</b>	<b>BB 2</b>	<b>6.19E-06</b>	<b>BB 2</b>
Eu 155		8		8	<b>Total b/g</b>	<b>2.96E-05</b>	<b>BB 2</b>	<b>2.96E-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