

<b>WASTE STREAM</b>	<b>5C316</b>	<b>Solid Waste Complex Decommissioning 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 m <sup>3</sup>
Future arisings -	1.4.2027 - 31.3.2035.....	2771.0 m <sup>3</sup>
Total future arisings:		2771.0 m <sup>3</sup>
Total waste volume:		2771.0 m <sup>3</sup>
Comment on volumes:	Arisings due to decommissioning in the Solid Waste Complex. Volumes updated for 2016 RWI to reflect SMART Inventory Review	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.3
	Stock (lower): x	Arisings (lower) x 0.7

**WASTE SOURCE** Decommissioning of the solid waste complex.

**PHYSICAL CHARACTERISTICS**

General description: Hard metallic waste from decommissioning of cells, ventilation systems and pipework in facilities. The waste also includes concrete and building rubble.  
 Physical components (%vol): Metal, concrete and building rubble, cellulose, plastics and rubber.  
 Sealed sources: The waste does not contain sealed sources.  
 Bulk density (t/m<sup>3</sup>): ~2  
 Comment on density: Density based on density of a similar waste stream.

**CHEMICAL COMPOSITION**

General description and components (%wt): Metal, concrete and building rubble, cellulose, plastics and rubber.  
 Chemical state: Neutral  
 Chemical form of radionuclides: H-3: Activation product.  
 Ra: Decay product of fuel and sources.  
 Th: Present due to contamination as a metal or oxide  
 U: Present due to fuel contamination as metal or oxide.  
 Pu: Activation of fuel.  
 Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	P		
Other ferrous metals.....	~30.0	including a proportion of boronated steel - baffle plates (% TBC)	
Iron.....			
Aluminium.....	P		
Beryllium.....			
Cobalt.....			
Copper.....	P		
Lead.....	P		
Magnox/Magnesium.....	TR		
Nickel.....			

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Titanium.....			
Uranium.....			
Zinc.....	NE		
Zircaloy/Zirconium.....	TR		
Other metals.....	NE	Antimony and uranium may also be present.	
Organics (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	10.0		
Paper, cotton.....	P		
Wood.....	~10.0		
Halogenated plastics .....	P	PVC and PTFE	
Total non-halogenated plastics.....	NE		
Condensation polymers.....	NE		
Others.....	NE		
Organic ion exchange materials....	NE		
Total rubber.....	P		
Halogenated rubber .....	P	Hypalon and neoprene	
Non-halogenated rubber.....	NE		
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..	NE		
Inorganic sludges and flocs.....	NE		
Soil.....	NE		
Brick/Stone/Rubble.....	P		
Cementitious material.....	~60.0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			

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Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt):          Carbonate present in concrete.

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

Materials of interest for waste acceptance criteria:          -

	(%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:          -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		

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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:      Yes. Large Concrete Items (LCIs) may be DIs; drummed (ungROUTED)/"rubbleised" wastes assumed not DIs. Note - LCIs with embedded metals may also be DIs within DIs, depends on specific circumstances/waste form. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIs

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	Off-site	~~1.0
Supercompaction (HFC)		
Incineration		
Solidification	Off-site	~2.0
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various	97.0	
None		

Comment on planned treatments:

-

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	97.0	2.0
Expected to be consigned to a Landfill Facility		
Expected to be consigned to an On-Site Disposal Facility	1.0	0.40
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	2.0	1.4
Expected to be recycled / reused		
Disposal route not known		

Classification codes for waste expected to be consigned to a landfill facility: 17 04 05, 17 01 01, 17 02 01

**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:** (Not applicable to this waste stream)

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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			

Other information: -

**Waste Planned for Disposal at the LLW Repository:** (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (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: The radionuclide fingerprint (future arisings only) for this waste stream has been updated using data from waste stream 5C39.

Uncertainty: The above radionuclides are expected to be present but dominated by Co60 and Cs137. Full characterisation will be undertaken near to the start of decommissioning.

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: The above radionuclides are expected to be present but dominated by Co60 and Cs137. Full characterisation will be undertaken near to the start of decommissioning.

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			3.08E-06	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14				8	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36				8	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				6	Pb 210		1.64E-09	CC 2	8
Co 60			1.32E-05	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63				6	Po 210		1.42E-09	CC 2	8
Zn 65				8	Ra 223				8
Se 79				8	Ra 225				8
Kr 81				8	Ra 226		1.42E-08	CC 2	8
Kr 85				8	Ra 228		1.87E-07	CC 2	8
Rb 87				8	Ac 227				8
Sr 90			3.01E-05	CC 2	Th 227				8
Zr 93				8	Th 228		1.3E-07	CC 2	8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m				8	Th 232		3.29E-07	CC 2	8
Nb 94				8	Th 234		3.14E-07	CC 2	8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106			8.24E-09	CC 2	U 233				8
Pd 107				8	U 234		9.71E-08	CC 2	8
Ag 108m				8	U 235		2.37E-08	CC 2	8
Ag 110m				8	U 236				8
Cd 109				8	U 238		3.14E-07	CC 2	8
Cd 113m				6	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		5.48E-07	CC 2	8
Sn 123				8	Pu 239		3.29E-06	CC 2	8
Sn 126				8	Pu 240		3E-07	CC 2	8
Sb 125				8	Pu 241		3.91E-05	CC 2	8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241		5.84E-06	CC 2	8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134			4.54E-08	CC 2	Cm 242				6
Cs 135				8	Cm 243				8
Cs 137			4.74E-05	CC 2	Cm 244		1.31E-07	CC 2	8
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				8	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				8
Eu 152				6	Other b/g				8
Eu 154			9.42E-07	CC 2	<b>Total a</b>	<b>0</b>	<b>1.10E-05</b>	<b>CC 2</b>	8
Eu 155			3.05E-07	CC 2	<b>Total b/g</b>	<b>0</b>	<b>1.35E-04</b>	<b>CC 2</b>	8

**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