

WASTE STREAM	5C300	Land Remediation VLLW and LA-LLW
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SITE Harwell
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE VLLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	431.9 m ³
Future arisings -	1.4.2021 - 31.3.2026.....	9652.7 m ³
Total future arisings:		9652.7 m ³
Total waste volume:		10084.6 m ³

Comment on volumes: VLLW and LA-LLW soil and rubble arising from Harwell Land remediation. This excludes LETP Land remediation as this is now captured under 5C323 and 5C324. Volumes updated for 2016 RWI to reflect SMART Inventory Review. Original 5C300 waste stream has been refined for 2016 UKRWI by creating additional waste streams to provide improved clarity. This stream now only covers Harwell land remediation excluding LETP.

Uncertainty factors on volumes:

Stock (upper):	x 1.1	Arisings (upper)	x 2.0
Stock (lower):	x 0.9	Arisings (lower)	x 0.9

WASTE SOURCE -

PHYSICAL CHARACTERISTICS

General description: Predominantly soil and drainage pipework. There should be no large items in this waste stream. Land and buildings on the Harwell site, contaminated as a result of past operations.

Physical components (%wt): Metal (49%), concrete/rubble (36%), soil (11%), Other (4%).

Sealed sources: -

Bulk density (t/m³): ~0.76

Comment on density: Taken from WCH mass and volume data.

CHEMICAL COMPOSITION

General description and components (%wt): Metal (49%), concrete/rubble (36%), soil (11%), Other (4%).

Chemical state: Alkali

Chemical form of radionuclides: -

Metals and alloys (%wt): -

Stainless steel.....	TR	Small amounts of stainless steel
Other ferrous metals.....		
Iron.....	~49.0	Cast Iron Pipework
Aluminium.....	NE	
Beryllium.....		
Cobalt.....		
Copper.....	NE	
Lead.....	~0.60	Solid Lead gaskets between ODP pipes
Magnox/Magnesium.....	NE	
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....	NE	

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	Zircaloy/Zirconium.....	NE	
	Other metals.....	NE	
Organics (%wt):	-		
	Total cellulose.....	NE	
	Paper, cotton.....	NE	
	Wood.....	~1.0	
	Halogenated plastics	~1.0	Small amounts of plastic pipework - PVC
	Total non-halogenated plastics.....	NE	
	Condensation polymers.....	NE	
	Others.....	NE	
	Organic ion exchange materials....	NE	
	Total rubber.....	NE	
	Halogenated rubber	NE	
	Non-halogenated rubber.....	NE	
	Hydrocarbons.....		
	Oil or grease		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	NE	
Other materials (%wt):	-		
	Inorganic ion exchange materials.	NE	
	Inorganic sludges and flocs.....	NE	
	Soil.....	~11.0	
	Brick/Stone/Rubble.....	~36.0	
	Cementitious material.....	NE	
	Sand.....		
	Glass/Ceramics.....	NE	
	Graphite.....	NE	
	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.....	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:

This includes strong oxidising agents, strongly acidic or alkaline compounds and corrosive materials.

Combustible metals.....	
Low flash point liquids.....	
Explosive materials.....	
Phosphorus.....	
Hydrides.....	
Biological etc. materials.....	
Biodegradable materials.....	1.0
Putrescible wastes.....	~1.0
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	Off-site	2.0
Solidification		
Decontamination		
Metal treatment	Off-site	54.0
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		44.0

Comment on planned treatments:

It is intended that 44% of this waste stream will be disposed of via controlled burial to an off-site landfill, therefore no waste containers will be produced.

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Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	44.0
Expected to be consigned to a Landfill Facility	
Expected to be consigned to an On-Site Disposal Facility	2.0
Expected to be consigned to an Incineration Facility	
Expected to be consigned to a Metal Treatment Facility	54.0
Expected to be consigned as Out of Scope	
Expected to be recycled / reused	
Disposal route not known	

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: (Not applicable to this waste stream)

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			

Other information: -

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

Container voidage: -

Waste Characterisation Form (WCH): The waste does not have 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:	Contamination as a result of past operations.
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:	data taken from WCH: 1MXN-2HAR-0-WCH-0-4545 (ref date 2018) and decayed by one year for stocks to 2019 and three years to 2021 for arisings.
Other information:	-

WASTE STREAM

5C300

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	2.43E-06	CC 2	2.17E-06	CC 2	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	5.04E-07	CC 2	5.04E-07	CC 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	4.77E-09	CC 2	2.87E-09	CC 2	Pb 210	4.47E-09	CC 2	5.48E-09	CC 2
Co 60	1.94E-06	CC 2	1.49E-06	CC 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	5.08E-07	CC 2	5.01E-07	CC 2	Po 210	3.57E-09	CC 2	5.18E-09	CC 2
Zn 65		8		8	Ra 223		8		8
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226	2.15E-08	CC 2	2.15E-08	CC 2
Kr 85		8		8	Ra 228	2.41E-08	CC 2	5.88E-08	CC 2
Rb 87		8		8	Ac 227		8		8
Sr 90	2.3E-07	CC 2	2.2E-07	CC 2	Th 227		8		8
Zr 93		8		8	Th 228	5.57E-09	CC 2	2.55E-08	CC 2
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230	2.76E-08	CC 2	2.76E-08	CC 2
Nb 93m		8		8	Th 232	1.86E-07	CC 2	1.86E-07	CC 2
Nb 94		8		8	Th 234	6.02E-07	CC 2	6.02E-07	CC 2
Mo 93		8		8	Pa 231		8		8
Tc 97		8		8	Pa 233	1.04E-08	CC 2	1.04E-08	CC 2
Tc 99		8		8	U 232		8		8
Ru 106		8		8	U 233	1.05E-08	CC 2	1.05E-08	CC 2
Pd 107		8		8	U 234	7.66E-08	CC 2	7.66E-08	CC 2
Ag 108m		8		8	U 235	2.48E-08	CC 2	2.48E-08	CC 2
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238	6.02E-07	CC 2	6.02E-07	CC 2
Cd 113m		8		8	Np 237	1.04E-08	CC 2	1.04E-08	CC 2
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	1.77E-07	CC 2	1.74E-07	CC 2
Sn 123		8		8	Pu 239	4.6E-07	CC 2	4.6E-07	CC 2
Sn 126		8		8	Pu 240	4.6E-07	CC 2	4.6E-07	CC 2
Sb 125		8		8	Pu 241	1.6E-06	CC 2	1.45E-06	CC 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	5.56E-07	CC 2	5.59E-07	CC 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	4.81E-06	CC 2	4.59E-06	CC 2	Cm 244		8		8
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	8.81E-08	CC 2	7.95E-08	CC 2	Other b/g				
Eu 154	9.69E-08	CC 2	8.24E-08	CC 2	Total a	2.62E-06	CC 2	2.64E-06	CC 2
Eu 155	6.65E-09	CC 2	4.99E-09	CC 2	Total b/g	1.29E-05	CC 2	1.18E-05	CC 2

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