WASTE STREAM 5C300 Land Remediation VLLW and LA-LLW

SITE	Harwell
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	VLLW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	868.8 m³
Future arisings -	1.4.2022 - 31.3.2027.....	7822.7 m³
Total future arisings:		7822.7 m³
Total waste volume:		8691.4 m³

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 This waste stream covers the remaining historic solid VLLW and LA-LLW from various legacy land decommissioning projects on the Harwell site.

PHYSICAL CHARACTERISTICS

General description: The waste generated consists mainly of soil, rubble, concrete, clay, cast iron pipework, steel pipework, some plastic pipework and small amounts of lead, rebar and combustible PPE and housekeeping wastes. 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: The waste does not contain 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): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
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
Zircaloy/Zirconium	NE
Other metals	NE

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	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): -

	(%wt)	Type(s) and comment	% of total C14 activity
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	0		
Non/low friable			

Moderately friable.....

Highly friable.....

Free aqueous liquids.....

Free non-aqueous liquids.....

Powder/Ash.....

Inorganic anions (%wt): -

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

	(%wt)	Type(s) and comment
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.....		
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / non hazardous pollutants: -

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

WASTE STREAM 5C300 Land Remediation VLLW and LA-LLW

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): No

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....		
Total complexing agents.....	0	

Potential for the waste to contain discrete items: Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIsLarge Concrete Items (LCIs) may be DIs; drummed (ungrouted)/"rubbleised" wastes assumed not DIs

WASTE STREAM 5C300 Land Remediation VLLW and LA-LLW

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		
Recyling / 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.

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	44.0	0.76
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	2.0	0.40
Expected to be consigned to a Metal Treatment Facility	54.0	1.4
Expected to be consigned as Out of Scope		
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 05 03*/04

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)

WASTE STREAM 5C300 Land Remediation VLLW and LA-LLW

Container	Stream volume %	Waste loading m³	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: 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 V3 (activity ref date 2018) and decayed by 3 years for RWI 2022.

Other information: -

WASTE STREAM 5C300 Land Remediation VLLW and LA-LLW

Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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	2.05E-06	C C 2	2.05E-06	C C 2	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	5.04E-07	C C 2	5.04E-07	C C 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	2.23E-09	C C 2	2.23E-09	C C 2	Pb 210	5.96E-09	C C 2	5.96E-09	C C 2
Co 60	1.31E-06	C C 2	1.31E-06	C C 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	4.98E-07	C C 2	4.98E-07	C C 2	Po 210	5.69E-09	C C 2	5.69E-09	C C 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	C C 2	2.15E-08	C C 2
Kr 85		8		8	Ra 228	7.34E-08	C C 2	7.34E-08	C C 2
Rb 87		8		8	Ac 227		8		8
Sr 90	2.15E-07	C C 2	2.15E-07	C C 2	Th 227		8		8
Zr 93		8		8	Th 228	3.8E-08	C C 2	3.8E-08	C C 2
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230	2.76E-08	C C 2	2.76E-08	C C 2
Nb 93m		8		8	Th 232	1.86E-07	C C 2	1.86E-07	C C 2
Nb 94		8		8	Th 234	6.02E-07	C C 2	6.02E-07	C C 2
Mo 93		8		8	Pa 231		8		8
Tc 97		8		8	Pa 233	1.04E-08	C C 2	1.04E-08	C C 2
Tc 99		8		8	U 232		8		8
Ru 106		8		8	U 233	1.05E-08	C C 2	1.05E-08	C C 2
Pd 107		8		8	U 234	7.66E-08	C C 2	7.66E-08	C C 2
Ag 108m		8		8	U 235	2.48E-08	C C 2	2.48E-08	C C 2
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238	6.02E-07	C C 2	6.02E-07	C C 2
Cd 113m		8		8	Np 237	1.04E-08	C C 2	1.04E-08	C C 2
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	1.72E-07	C C 2	1.72E-07	C C 2
Sn 123		8		8	Pu 239	4.6E-07	C C 2	4.6E-07	C C 2
Sn 126		8		8	Pu 240	4.6E-07	C C 2	4.6E-07	C C 2
Sb 125		8		8	Pu 241	1.38E-06	C C 2	1.38E-06	C C 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	5.6E-07	C C 2	5.6E-07	C C 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	4.49E-06	C C 2	4.49E-06	C C 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	7.55E-08	C C 2	7.55E-08	C C 2	Other b/g				
Eu 154	7.63E-08	C C 2	7.63E-08	C C 2	**Total a**	**2.66E-06**	**C C 2**	**2.66E-06**	**C C 2**
Eu 155	4.33E-09	C C 2	4.33E-09	C C 2	**Total b/g**	**1.13E-05**	**C C 2**	**1.13E-05**	**C C 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