

WASTE STREAM	5C328	BEPO Reactor Decommissioning VLLW and LA-LLW
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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.....	38.0 m ³
Future arisings -	1.4.2022 - 31.3.2026.....	5020.0 m ³
Total future arisings:		5020.0 m ³
Total waste volume:		5058.0 m ³
Comment on volumes:	VLLW and LA-LLW soil and rubble arising from buildings decommissioning. Volumes updated for 2016 RWI to reflect SMART Inventory Review. This waste was originally part of 5C300 but this has been split to provide greater clarity.	
Uncertainty factors on volumes:	Stock (upper): x 1.2	Arisings (upper) x 2.0
	Stock (lower): x 0.8	Arisings (lower) x 0.2

WASTE SOURCE VLLW and LA-LLW arising from decommissioning of BEPO reactor and associated buildings.

PHYSICAL CHARACTERISTICS

General description: Predominantly soil. 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): Soil ~85%; concrete/rubble ~15%.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.4

Comment on density: Average density for soil.

CHEMICAL COMPOSITION

General description and components (%wt): Soil ~85%; concrete/rubble ~15%.

Chemical state: -

Chemical form of radionuclides: -

Metals and alloys (%wt): There should be no sheet metal or bulk metal items present in the waste stream.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....	NE		
Iron.....			
Aluminium.....	NE		
Beryllium.....	NE		
Cobalt.....			
Copper.....	NE		
Lead.....	NE		
Magnox/Magnesium.....	NE		
Nickel.....			
Titanium.....			

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Uranium.....	NE		
Zinc.....	NE		
Zircaloy/Zirconium.....	NE		
Other metals.....	NE		
Organics (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	NE		
Paper, cotton.....	NE		
Wood.....	NE		
Halogenated plastics	NE		
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.....	~~85.0		
Brick/Stone/Rubble.....	~~10.0		
Cementitious material.....	~~5.0		
Sand.....			
Glass/Ceramics.....	NE		
Graphite.....	NE		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....			

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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: -

	(%wt)	Type(s) and comment
Combustible metals.....		
Low flash point liquids.....		
Explosive materials.....		
Phosphorus.....		
Hydrides.....		
Biological etc. materials.....		
Biodegradable materials.....	0	
Putrescible wastes.....		
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.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		

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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.....

Potential for the waste to contain discrete items: Not yet determined. Soil - In & of itself not a DI Large Concrete Items (LCIs) may be DIs; drummed (ungROUTED)/"rubbleised" wastes assumed not 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 Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None		100.0

Comment on planned treatments:

It is intended that the wastestream will be disposed of via controlled burial to an off-site landfill, therefore no waste containers will be produced. Disposal to landfill is expected to be in 1m3 bags.

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	1.4

Classification codes for waste expected to be consigned to a landfill facility: 17 05 03*/17 05 04, 17 01 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 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): -

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: Specific activity estimates are based on consignments from this stream in 2012. These are the best estimates currently, but some areas have yet to be characterised, and so values may change as more data becomes available. Activities decayed to reflect arising date for 2022 UKRWI.

Other information: -

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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		8		8	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	6.54E-09	BB 2	6.54E-09	BB 2
Co 60	6.05E-08	BB 2	6.05E-08	BB 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63		8		8	Po 210	6.19E-09	BB 2	6.19E-09	BB 2
Zn 65		8		8	Ra 223	1.36E-09	BB 2	1.36E-09	BB 2
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226	2.72E-08	BB 2	2.72E-08	BB 2
Kr 85		8		8	Ra 228	1.49E-09	BB 2	1.49E-09	BB 2
Rb 87		8		8	Ac 227	1.36E-09	BB 2	1.36E-09	BB 2
Sr 90		8		8	Th 227	1.34E-09	BB 2	1.34E-09	BB 2
Zr 93		8		8	Th 228		8		8
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230	2.72E-08	BB 2	2.72E-08	BB 2
Nb 93m		8		8	Th 232	2.26E-09	BB 2	2.26E-09	BB 2
Nb 94		8		8	Th 234	2.72E-08	BB 2	2.72E-08	BB 2
Mo 93		8		8	Pa 231	1.36E-09	BB 2	1.36E-09	BB 2
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	2.72E-08	BB 2	2.72E-08	BB 2
Ag 108m		8		8	U 235	1.36E-09	BB 2	1.36E-09	BB 2
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238	2.72E-08	BB 2	2.72E-08	BB 2
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	1.45E-08	BB 2	1.45E-08	BB 2
Sn 123		8		8	Pu 239	2.15E-07	BB 2	2.15E-07	BB 2
Sn 126		8		8	Pu 240	2.15E-07	BB 2	2.15E-07	BB 2
Sb 125		8		8	Pu 241	2.05E-07	BB 2	2.05E-07	BB 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	1.93E-07	BB 2	1.93E-07	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	1.88E-07	BB 2	1.88E-07	BB 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		8	Other b/g				
Eu 154		8		8	Total a	7.60E-07	BB 2	7.60E-07	BB 2
Eu 155		8		8	Total b/g	4.90E-07	BB 2	4.90E-07	BB 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