

WASTE STREAM	2D116	Miscellaneous Plants Initial/Interim Decommissioning: Processing Plants, Tanks, Silos etc.
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SITE Sellafield
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Sellafield Limited
WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m ³
Future arisings -	1.4.2019 - 31.3.2022.....	0 m ³
	1.4.2022 - 31.3.2024.....	77.2 m ³
	1.4.2024 - 31.3.2025.....	102.6 m ³
	1.4.2025 - 31.3.2026.....	129.0 m ³
	1.4.2026 - 31.3.2027.....	190.1 m ³
	1.4.2027 - 31.3.2028.....	304.4 m ³
	1.4.2028 - 31.3.2029.....	210.8 m ³
	1.4.2029 - 31.3.2030.....	247.6 m ³
	1.4.2030 - 31.3.2031.....	257.2 m ³
	1.4.2031 - 31.3.2032.....	269.3 m ³
	1.4.2032 - 31.3.2033.....	269.3 m ³
	1.4.2033 - 31.3.2034.....	270.5 m ³
	1.4.2034 - 31.3.2035.....	415.3 m ³
	1.4.2035 - 31.3.2036.....	417.3 m ³
	1.4.2036 - 31.3.2037.....	394.6 m ³
	1.4.2037 - 31.3.2038.....	395.4 m ³
	1.4.2038 - 31.3.2039.....	357.8 m ³
	1.4.2039 - 31.3.2040.....	262.5 m ³
	1.4.2040 - 31.3.2041.....	294.7 m ³
	1.4.2041 - 31.3.2042.....	277.9 m ³
	1.4.2042 - 31.3.2043.....	329.2 m ³
	1.4.2043 - 31.3.2044.....	344.0 m ³
	1.4.2044 - 31.3.2045.....	345.7 m ³
	1.4.2045 - 31.3.2046.....	434.5 m ³
	1.4.2046 - 31.3.2047.....	347.1 m ³
	1.4.2047 - 31.3.2048.....	340.4 m ³
	1.4.2048 - 31.3.2049.....	365.3 m ³
	1.4.2049 - 31.3.2050.....	364.1 m ³
	1.4.2050 - 31.3.2051.....	364.1 m ³
	1.4.2051 - 31.3.2052.....	364.1 m ³
	1.4.2052 - 31.3.2053.....	356.7 m ³
	1.4.2053 - 31.3.2054.....	255.8 m ³
	1.4.2054 - 31.3.2055.....	254.4 m ³
	1.4.2055 - 31.3.2056.....	246.8 m ³
	1.4.2056 - 31.3.2057.....	245.0 m ³
	1.4.2057 - 31.3.2058.....	308.9 m ³
	1.4.2058 - 31.3.2059.....	281.2 m ³
	1.4.2059 - 31.3.2060.....	276.7 m ³
	1.4.2060 - 31.3.2061.....	272.1 m ³
	1.4.2061 - 31.3.2062.....	269.9 m ³
	1.4.2062 - 31.3.2063.....	269.9 m ³
	1.4.2063 - 31.3.2064.....	252.1 m ³
	1.4.2064 - 31.3.2065.....	250.4 m ³
	1.4.2065 - 31.3.2067.....	498.8 m ³
	1.4.2067 - 31.3.2069.....	430.1 m ³
	1.4.2069 - 31.3.2070.....	140.1 m ³
	1.4.2070 - 31.3.2071.....	132.0 m ³
	1.4.2071 - 31.3.2072.....	134.4 m ³
	1.4.2072 - 31.3.2074.....	329.8 m ³
	1.4.2074 - 31.3.2082.....	1142.0 m ³

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1.4.2082 - 31.3.2084.....	280.5 m ³
1.4.2084 - 31.3.2085.....	128.9 m ³
1.4.2085 - 31.3.2087.....	245.5 m ³
1.4.2087 - 31.3.2091.....	485.4 m ³
1.4.2091 - 31.3.2092.....	132.2 m ³
1.4.2092 - 31.3.2095.....	60.5 m ³
1.4.2095 - 31.3.2102.....	158.4 m ³
1.4.2102 - 31.3.2104.....	26.6 m ³
1.4.2104 - 31.3.2106.....	22.7 m ³
1.4.2106 - 31.3.2107.....	8.9 m ³
1.4.2107 - 31.3.2108.....	12.8 m ³
1.4.2109 - 31.3.2112.....	199.6 m ³
1.4.2112 - 31.3.2114.....	56.9 m ³
1.4.2114 - 31.3.2115.....	25.7 m ³
1.4.2115 - 31.3.2117.....	37.7 m ³
1.4.2117 - 31.3.2118.....	27.8 m ³
1.4.2118 - 31.3.2119.....	20.4 m ³
1.4.2119 - 31.3.2120.....	11.4 m ³
1.4.2120 - 31.3.2121.....	0 m ³

Total future arisings: 17030.7 m³

Total waste volume: 17030.7 m³

Comment on volumes: Arisings are in line with current decommissioning programmes and strategy. Arisings are from future decommissioning projects. Waste within this waste stream is generated from a number of decommissioning projects which will commence at a future date. As a result of this, minimal characterisation of waste volumes and fingerprints has been carried out and hence there is a large uncertainty in the potential arisings. Preliminary assessments indicate that the volumes may vary from -30% to +200% for ILW.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 3.0
Stock (lower): x Arisings (lower) x 0.7

WASTE SOURCE Dismantling of reprocessing and associated plants, waste storage and treatment plants and site services facilities.

PHYSICAL CHARACTERISTICS

General description: Plant and equipment, internal building fabric and soft waste ie. rubber/PVC/paper. Most items size reduced in-situ. Some large items may be present.

Physical components (%vol): Vessels, tanks (64%), gloveboxes (3%), pipework, valves and fittings (11%), plant and equipment (10%), ducting (3%), soft waste (9%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.5

Comment on density: Density stated is average for ILW and includes some voidage.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless steel (76.5%), mild steel (14%), copper (0.2%), aluminium (0.1%), zinc (<0.1%), plastic (6%), rubber (2%), glass (0.1%), cellulose (1%). Percentages are by volume.

Chemical state: Neutral

Chemical form of radionuclides: Cl-36: Not expected to be present in significant quantity.
Se-79: Not expected to be present in significant quantity.
Ra: Not expected to be present in significant quantity.
Th: Not expected to be present in significant quantity.

Metals and alloys (%wt): Some sheet metal present (~30%), bulk metal (70%).

Stainless steel.....	76.5	The most commonly used stainless steel is 304L.
Other ferrous metals.....	14.0	
Iron.....	P	Cast iron may be present but the quantity is dependent on Plant POCO not yet started.
Aluminium.....	0.10	

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Beryllium.....	0
Cobalt.....	0
Copper.....	0.20
Lead.....	TR
Magnox/Magnesium.....	0
Nickel.....	0
Titanium.....	
Uranium.....	P
Zinc.....	<0.10
Zircaloy/Zirconium.....	0
Other metals.....	0

Organics (%wt):

The waste contains PVC and other plastics, small amounts of rubber and cellulose. Percentages are by volume. PVC oversuits, Windscale suits, waste bags, rubber gloves.

Total cellulosics.....	1.0
Paper, cotton.....	TR
Wood.....	~1.0
Halogenated plastics	4.5
Total non-halogenated plastics.....	1.5
Condensation polymers.....	0.75
Others.....	0.75
Organic ion exchange materials....	0
Total rubber.....	2.0
Halogenated rubber	P
Non-halogenated rubber.....	P
Hydrocarbons.....	
Oil or grease	
Fuel.....	
Asphalt/Tarmac (cont.coal tar)...	
Asphalt/Tarmac (no coal tar)....	
Bitumen.....	
Others.....	
Other organics.....	0

Other materials (%wt):

-	
Inorganic ion exchange materials.	0
Inorganic sludges and flocs.....	TR
Soil.....	0
Brick/Stone/Rubble.....	TR
Cementitious material.....	TR
Sand.....	0
Glass/Ceramics.....	~0.10
Graphite.....	0
Desiccants/Catalysts.....	0
Asbestos.....	TR

Due to the age of facilities covered by this waste stream

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trace amounts of white, blue and brown asbestos may be present.

	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	Inorganic anions are not expected to be present.	
	Fluoride.....	0
	Chloride.....	0
	Iodide.....	0
	Cyanide.....	0
	Carbonate.....	0
	Nitrate.....	0
	Nitrite.....	0
	Phosphate.....	0
	Sulphate.....	0
	Sulphide.....	0
Materials of interest for waste acceptance criteria:	-	
	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.....	0
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	0
	Active particles.....	NE
	Soluble solids as bulk chemical compounds.....	0
Hazardous substances / non hazardous pollutants:	Lead is present in trace quantities. Asbestos.	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	

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Phenol.....
 Styrene.....
 Tri-butyl phosphate.....
 Other organophosphates.....
 Vinyl chloride.....
 Arsenic.....
 Barium.....
 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): No
 EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

PACKAGING AND CONDITIONING

Conditioning method: The waste will be subject to in-situ size reduction prior to placing in one of the following options, a 500 l drum, a 3 m³ Decommissioning Concrete Container (DCC) or a 3 m³ box liner. No further size reduction or compaction will be carried out. Waste in drums will be vibro-encapsulated where the other containers may be flood grouted if required for disposal.

Plant Name: Magnox Encapsulation Plant, Box Encapsulation Plant, Low End Encapsulation Capability and future replacement facilities.

Location: Sellafield.

Plant startup date: MEP already operational, BEP 2022, LEEC 2023.

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: 2022

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Other information: LEEC treatment capability and capacity are currently under development. Use of BEP is dependent on spare operating capacity being released from High hazard and risk reduction priorities.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l drum	~5.5	~0.11	0.45	8516
	Sellafield 3m ³ box	~55.5	~0.51	2.1	18534
	Other(DCC)	~39.0	~0.51	~2.1	13024

Likely container type comment: DCC - external envelope of a Sellafield 3 m³ box however it is made of fibre-reinforced concrete. Note 0.5% included within the Sellafield 3 m³ type may be consigned to MBGWS prior to conditioning for disposal.

Range in container waste volume: The volume of raw waste in a container can vary from 5% to 65% by volume (Note a full container of dry sharp sand would be 50% by volume).

Other information on containers: Stainless Steel for 500 l drums, Sellafield 3m³ box and decommissioning liner used to load boxes. Fibre reinforced concrete for DCC.

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m³): ~1.0

Conditioned density comment: Conditioned waste density varies depending on waste loading.

Other information on conditioning: -

Opportunities for alternative disposal routing: Not yet determined

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source: The main sources of activity are actinides and fission products.

Uncertainty: Waste within this waste stream is generated from a number of decommissioning projects which will commence at a future date. The uncertainties quoted for each nuclide represent both the uncertainty in quantification without detailed sampling and the likely variation of nuclide in different building consigned wastes under this waste stream. It is exceptionally unlikely that all the waste included in this waste stream will have the same variation in nuclide fingerprint. Also activity levels will depend on degree of decontamination achieved.

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: -

Other information: Other alpha not specified. Other beta/gamma includes Zr95 2.33E-5 TBq/m³, Nb95 3.8E-5 TBq/m³ and Ru103 3.02E-6 TBq/m³. Other nuclides not specified.

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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			1.66E-05	CC 2	Gd 153				
Be 10				8	Ho 163				
C 14			6.00E-05	CC 2	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36				8	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41				8	Pt 193				
Mn 53					Tl 204				
Mn 54			1.44E-08	CC 2	Pb 205				
Fe 55			2.24E-06	CC 2	Pb 210				8
Co 60			3.80E-05	CC 2	Bi 208				
Ni 59				8	Bi 210m				
Ni 63			1.42E-05	CC 2	Po 210				8
Zn 65			1.44E-08	CC 2	Ra 223				
Se 79				8	Ra 225				
Kr 81					Ra 226				8
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90			9.44E-03	CC 2	Th 227				
Zr 93			2.51E-08	CC 2	Th 228				
Nb 91					Th 229				8
Nb 92					Th 230				8
Nb 93m				8	Th 232				8
Nb 94				8	Th 234				
Mo 93				8	Pa 231				8
Tc 97					Pa 233				
Tc 99			2.79E-05	CC 2	U 232				
Ru 106			1.59E-04	CC 2	U 233				8
Pd 107				8	U 234		1.42E-05	CC 2	
Ag 108m				8	U 235		4.92E-07	CC 2	
Ag 110m					U 236				8
Cd 109					U 238		1.96E-05	CC 2	
Cd 113m					Np 237		1.03E-05	CC 2	
Sn 119m					Pu 236				
Sn 121m				8	Pu 238		1.19E-04	CC 2	
Sn 123					Pu 239		1.85E-03	CC 2	
Sn 126				8	Pu 240		3.12E-04	CC 2	
Sb 125					Pu 241		3.41E-03	CC 2	
Sb 126					Pu 242		3.92E-11	CC 2	
Te 125m					Am 241		1.57E-04	CC 2	
Te 127m					Am 242m				8
I 129			3.15E-08	CC 2	Am 243				8
Cs 134			3.12E-04	CC 2	Cm 242		3.06E-08	CC 2	
Cs 135				8	Cm 243		3.42E-07	CC 2	
Cs 137			5.21E-02	CC 2	Cm 244		2.07E-05	CC 2	
Ba 133					Cm 245				8
La 137					Cm 246				8
La 138					Cm 248				
Ce 144			1.17E-04	CC 2	Cf 249				
Pm 145					Cf 250				
Pm 147			1.97E-06	CC 2	Cf 251				
Sm 147					Cf 252				
Sm 151			7.94E-06	CC 2	Other a		1.34E-06	CC 2	
Eu 152			6.26E-08	CC 2	Other b/g		8.92E-05	CC 2	
Eu 154			9.72E-06	CC 2	Total a	0	2.51E-03	CC 2	
Eu 155			1.59E-06	CC 2	Total b/g	0	6.58E-02	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