

<b>WASTE STREAM</b>	<b>2D137</b>	<b>Miscellaneous Plants Final Decommissioning: Processing Plants, Tanks, Silos, etc.</b>
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**SITE** Sellafield

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Sellafield Limited

**WASTE TYPE** ILW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	0 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2023.....	0 m <sup>3</sup>
	1.4.2023 - 31.3.2024.....	0 m <sup>3</sup>
	1.4.2024 - 31.3.2025.....	0 m <sup>3</sup>
	1.4.2025 - 31.3.2042.....	~0 m <sup>3</sup>
	1.4.2042 - 31.3.2043.....	~1.0 m <sup>3</sup>
	1.4.2043 - 31.3.2044.....	~0.4 m <sup>3</sup>
	1.4.2044 - 31.3.2051.....	~0 m <sup>3</sup>
	1.4.2051 - 31.3.2052.....	~15.0 m <sup>3</sup>
	1.4.2052 - 31.3.2078.....	~0 m <sup>3</sup>
	1.4.2078 - 31.3.2101.....	~11456.0 m <sup>3</sup>
	1.4.2101 - 31.3.2104.....	~996.0 m <sup>3</sup>
	1.4.2104 - 31.3.2120.....	~0 m <sup>3</sup>
Total future arisings:		12468.4 m <sup>3</sup>
Total waste volume:		12468.4 m <sup>3</sup>

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** Final decommissioning of processing plants, tanks, silos and service facilities.

**PHYSICAL CHARACTERISTICS**

General description: Building structural materials, surface scabblings. Some large blocks of building structure may be present.

Physical components (%vol): Concrete, bricks and blockwork (100%). Note small amounts of reinforcing steelwork may be present if large blocks of material consigned.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~1

Comment on density: Density stated is average for ILW final decommissioning.

**CHEMICAL COMPOSITION**

General description and components (%wt): Concrete (including reinforcing bar), bricks and blockwork (100%).

Chemical state: Alkali

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): -

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	P		
Iron.....	P	Cast iron may be present but the quantity is dependent on Plant POCO not yet started.	
Aluminium.....			
Beryllium.....	0		
Cobalt.....	0		
Copper.....			
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....			
Titanium.....			
Uranium.....	0		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	0		
Organics (%wt):	None present		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics .....	0		
Total non-halogenated plastics.....	0		
Condensation polymers.....	0		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0		
Halogenated rubber .....	0		
Non-halogenated rubber.....	0		
Hydrocarbons.....			
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		
Other materials (%wt):	-		

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	100.0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	0		
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.

	(%wt)	Type(s) and comment
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:           None present.

	(%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.....	0	

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	NE
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / -  
non hazardous pollutants:

(%wt) Type(s) and comment

Acrylamide.....
Benzene.....
Chlorinated solvents.....
Formaldehyde.....
Organometallics.....
Phenol.....
Styrene.....
Tri-butyl phosphate.....
Other organophosphates.....
Vinyl chloride.....
Arsenic.....
Barium.....
Boron.....
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.....

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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 number of uniform concrete blocks.

**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 3 m<sup>3</sup> Decommissioning Concrete Container (DCC), a 3 m<sup>3</sup> box liner or direct into a 3 m<sup>3</sup> box without liner. No further size reduction or compaction will be carried out. Waste may be flood grouted if required for disposal.

Plant Name: Box Encapsulation Plant, Low End Encapsulation Capability and future replacement facilities, Specific demolition treatment plant

Location: Sellafield.

Plant startup date: BEP 2025, LEEC 2027, Specific demolition Treatment Plant 2078

Total capacity (m<sup>3</sup>/y incoming waste): -

Target start date for packaging this stream: 2042

Throughput for this stream (m<sup>3</sup>/y incoming waste): -

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. For large through contaminated concrete structures it has been assumed that the waste will be maintained as discrete blocks rather than reduces the material to a rubble, this requires a dedicated facility.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	Sellafield 3m <sup>3</sup> box	~80.0	~1.13	~2.8	8828
	Other(DCC)	~20.0	~0.85	~2.15	2934

Likely container type comment: DCC - external envelope of a Sellafield 3 m<sup>3</sup> box however it is made of fiber reinforced concrete.

Range in container waste volume: The volume of raw demolition waste in a container can vary from 20% to 65% by volume (Note a full container of dry sharp sand would be 50% by volume).

Other information on containers: Stainless or duplex Steel(yet to be determined) for Sellafield 3m<sup>3</sup> box and decommissioning liner used to load boxes. Fibre reinforced concrete for DCC.

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m<sup>3</sup>): NE

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

Other information on conditioning: -

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Opportunities for alternative disposal routing: Not yet determined

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	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-6 TBq/m <sup>3</sup> , Nb95 3.8E-6 TBq/m <sup>3</sup> , Ru103 3.02E-7 TBq/m <sup>3</sup> and Ta182 1.59E-7 TBq/m <sup>3</sup> . Nuclides making up remaining "other beta/gamma" not specified.

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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			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			5.12E-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			7.94E-06	CC 2	Other b/g		9.08E-05	CC 2	
Eu 154			6.26E-08	CC 2	<b>Total a</b>	<b>0</b>	<b>&gt;2.51E-03</b>	<b>C 2</b>	
Eu 155			9.72E-06	CC 2	<b>Total b/g</b>	<b>0</b>	<b>&gt;6.49E-02</b>	<b>C 2</b>	

**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