

<b>WASTE STREAM</b>	<b>2D12</b>	<b>MBGW in PFSP</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.....	~243.1 m <sup>3</sup>
Total future arisings:	0 m <sup>3</sup>
Total waste volume:	243.1 m <sup>3</sup>

Comment on volumes: Volumes of the major components of this stream are estimated by assessing the number of skips containing them, the average percentage utilisation of a skip and the approximate voidage from video surveys. Other components have been evaluated by applying an estimated voidage to the volume of individual components and the number of each component type. Pond and Bay furniture has been estimated from drawings when available. Since November 2020, 24 baskets of debris comprising of swarf, calder support struts etc have been exported to WEP for entombment.

Uncertainty factors on volumes: Stock (upper): x 1.2 Arisings (upper) x  
Stock (lower): x 0.8 Arisings (lower) x

**WASTE SOURCE** Isotope and spent fuel handling operations, general production waste (including scrap equipment), some items from clean up/initial decommissioning of Windscale Piles. This stream now includes all the pond and bay furniture such as trollies, bogies, tables, tanks and decanner equipment.

**PHYSICAL CHARACTERISTICS**

General description: This stream is solid waste which includes isotope cartridges, reactor holding down weights and reactivity control cartridges, mops, buckets, clothing, scaffolding, wire, assorted scrap metal, boxes and baskets. These wastes arise from early site operations and the clean up of the Windscale Piles. Some items will need to be reduced in size before packaging, particularly in-pond storage boxes and redundant equipment. Also includes pond and bay furniture. The waste has not undergone any change since it was generated.

Physical components (%vol): ILW waste stream comprises the following: Isotopes (3.1%); Reactor components including holding down weights, support struts, flux flattening steels and empty isotope cans (4%); Magnox swarf, general waste items in skips including reactor thermocouple wire, boxes, baskets and miscellaneous scrap (86.5%); Pond and Bay furniture (6.4%). All

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~1.89

Comment on density: Weights and volumes for each component of this stream have been estimated from skip contents and tele/video surveys, and using drawings/data sheets of the individual items. Density quoted is gross weight divided by gross volume of the whole stream. Bulk density will vary substantially between different components.

**CHEMICAL COMPOSITION**

General description and components (%wt): Mild steel, stainless steel, aluminium, Magnox, nickel/chrome and nickel/aluminium (wire), cobalt, graphite, bismuth oxide, lead, lithium/magnesium alloy, aluminium nitride. Cellulosic material may be present.

Chemical state: Neutral

Chemical form of radionuclides: Ra: Present as metal.  
Th: No characterisation data available  
U: Present as metal.  
Pu: Present as metal.

Metals and alloys (%wt): Approximately 35% as bulk metal/sheet items, including 2 large sheets (1m by 2m) and various boxes, baskets and redundant plant items. Boxes typically 22x9x13 inches, baskets 10x15x44 inches. Large items of plant equipment in bays.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	19.4		
Other ferrous metals.....	46.7		
Iron.....			
Aluminium.....	1.2		
Beryllium.....	P		
Cobalt.....	0		
Copper.....	NE		
Lead.....	0.06		
Magnox/Magnesium.....	17.9		
Nickel.....			
Titanium.....	0		
Uranium.....	P		
Zinc.....	P		
Zircaloy/Zirconium.....	NE		
Other metals.....	P	Antimony, beryllium, lithium/magnesium alloy, nickel/chrome and nickel/aluminium. Weights not available, but all present individually in small quantities. Volumes of materials are difficult to quantify.	

Organics (%wt):                      Miscellaneous debris in pond may include paper, polythene sheet and bags, cable clips, contaminated clothing, etc. PVC and/or rubber may be present but only in small quantities.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	NE		
Paper, cotton.....	NE		
Wood.....	NE		
Halogenated plastics .....	NE		
Total non-halogenated plastics.....	NE		
Condensation polymers.....	NE		
Others.....	NE		
Organic ion exchange materials....	0		
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):                      -

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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.....	0		
Sand.....			
Glass/Ceramics.....			
Graphite.....	4.2		
Desiccants/Catalysts.....			
Asbestos.....	NE		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt):      Oxides, aluminate, nitrides. Activation products may include carbide in trace quantities.

	(%wt)	Type(s) and comment
Fluoride.....	NE	
Chloride.....	TR	
Iodide.....	NE	
Cyanide.....	0	
Carbonate.....	TR	
Nitrate.....	NE	
Nitrite.....	NE	
Phosphate.....	NE	
Sulphate.....	NE	
Sulphide.....	TR	

Materials of interest for waste acceptance criteria:      Toxic metals are generally contained in isotope cartridges. However, the integrity of the cartridges is unknown.

	(%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.....	
Reacting with water.....	
Higher activity particles.....	0
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / non hazardous pollutants:      Bismuth oxide, antimony, beryllium, uranium and lead are present. Weights undetermined, except for lead.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....	0	
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....	0	
Styrene.....		
Tri-butyl phosphate.....	0	
Other organophosphates.....		
Vinyl chloride.....	P	Trace in inventory.
Arsenic.....	0	
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	0	
Caesium.....		
Selenium.....	0	
Chromium.....	0	
Molybdenum.....	0	
Thallium.....		
Tin.....	0	
Vanadium.....	0	
Mercury compounds.....		
Others.....	0	
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): Not yet determined

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

Potential for the waste to contain discrete items: Not yet determined.

**PACKAGING AND CONDITIONING**

Conditioning method: The waste will be pretreated to conform to WEP/MBGWS conditions for acceptance. The ILW acceleration project has opened up routes to waste treatment facilities that already exist on site before BEP is operational e.g. WEP or MBGWS. Some wastes which are not compliant with WEP/MBGWS CFA may be stored within the Pond until the BUFT is available.

Plant Name: MBGWS, WEP, Box Encapsulation Plant (BEP)

Location: Sellafield

Plant startup date: 2025 (BEP) - Active contingency only.

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): -

Other information: Current baseline strategy is to export this waste stream in a combination of new and used Magnox skips as well as 300 litre liners via a 12 tonne flask or new C0 container. Work is ongoing in accelerating this strategy and size reduction, decontamination and segregation will be options in reducing the volume size of this stream so that a large % of it will eventually go as LLW.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
	500 l drum	~57.0	~0.25	0.47	555
	MBGWS box	23.0	1	3.5	56
	Other(HHISO containers)	20.0	NE	NE	NE

Likely container type comment: Packaging plans are being developed. However, waste package is likely to be an adaptation of the SDP double-skinned 3m³ box. Other: LLW for off-site metals treatment will be decontaminated through smelting to allow its free reuse. The furnace slag will be returned to LLWR for disposal in 2910 HHISO containers.

Range in container waste volume: -

Other information on containers: Stainless steel.

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m³): NE

Conditioned density comment: -

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Other information on conditioning: -

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	Recycling	~40.0	-	-	Significant amounts of bay steelwork are being decontaminated or size reduced to allow disposal as LLW or onward processing to allow free release.
Disposal at a Geological Disposal Facility	Metal treatment	30.0	NE	Medium	Assume that up to 30% may be routed to LLWR

### RADIOACTIVITY

Source: Activity originates from Cobalt and other isotope cartridges irradiated in Piles 1 and 2 and Calder reactors, activated fuel stringer and reactor control components. Also components such as bay pond furniture contaminated by fuel and pond water activity. Magnox swarf is now included in this stream.

Uncertainty: -

Definition of total alpha and total beta/gamma: The beta activity is derived from estimates of the known quantities of cobalt and other MBGW that comprise this waste stream.

Measurement of radioactivities: -

Other information: No information on other radionuclides.

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**MBGW in PFSP**

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	6.11E-07	EC 2			Gd 153				
Be 10	2.84E-10	BB 2			Ho 163				
C 14	2.12E-06	EB 2			Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36	3.93E-08	CB 2			Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41	2.65E-08	BB 2			Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55	3.97E-07	CB 2			Pb 210	6.56E-14	BB 2		
Co 60	1.79E-01	BB 2			Bi 208				
Ni 59	9.98E-05	CB 2			Bi 210m				
Ni 63	7.77E-03	CB 2			Po 210	6.24E-14	BA 2		
Zn 65					Ra 223	1.21E-12	BA 2		
Se 79	9.29E-10	CB 2			Ra 225	1.00E-15	BA 2		
Kr 81					Ra 226	2.64E-13	BA 2		
Kr 85	3.50E-06	BB 2			Ra 228				
Rb 87					Ac 227	1.22E-12	BA 2		
Sr 90	3.34E-04	BB 2			Th 227	1.19E-12	BA 2		
Zr 93	3.41E-08	BB 2			Th 228	2.29E-11	BA 2		
Nb 91					Th 229	1.00E-15	BA 2		
Nb 92					Th 230	3.50E-11	BA 2		
Nb 93m	2.17E-08	BB 2			Th 232	5.56E-18	BA 8		
Nb 94	2.29E-11	BB 2			Th 234	6.44E-08	BA 2		
Mo 93		8			Pa 231	2.87E-12	BA 2		
Tc 97					Pa 233	2.07E-09	BA 2		
Tc 99	2.66E-07	BB 2			U 232	2.23E-11	BA 2		
Ru 106		8			U 233	5.98E-13	BA 2		
Pd 107		8			U 234	5.99E-08	BA 2		
Ag 108m		8			U 235	1.93E-09	BA 2		
Ag 110m					U 236	5.14E-09	BA 2		
Cd 109					U 238	6.44E-08	BA 2		
Cd 113m	1.24E-09	BB 2			Np 237	2.07E-09	BA 2		
Sn 119m					Pu 236				
Sn 121m	2.83E-10	BB 2			Pu 238	2.80E-06	BA 2		
Sn 123					Pu 239	1.93E-05	BA 2		
Sn 126	5.17E-09	BB 2			Pu 240	1.58E-05	BA 2		
Sb 125	3.58E-11	BB 2			Pu 241	6.80E-05	BA 2		
Sb 126	7.24E-10	BB 2			Pu 242	4.43E-09	BA 2		
Te 125m	8.96E-12	BB 2			Am 241	3.62E-05	BA 2		
Te 127m					Am 242m	3.87E-08	BA 2		
I 129	4.63E-10	BB 2			Am 243	6.43E-09	BA 2		
Cs 134	9.46E-13	BB 2			Cm 242	3.20E-08	BA 2		
Cs 135	1.53E-08	BB 2			Cm 243	1.97E-09	BA 2		
Cs 137	4.58E-04	BB 2			Cm 244	9.74E-09	BA 2		
Ba 133					Cm 245	1.16E-12	BA 2		
La 137					Cm 246				
La 138					Cm 248				
Ce 144		8			Cf 249				
Pm 145					Cf 250				
Pm 147	6.97E-10	BB 2			Cf 251				
Sm 147	3.99E-18	BB 2			Cf 252				
Sm 151	4.78E-06	BB 2			Other a	5.58E-11	BA 2		
Eu 152	2.88E-08	BB 2			Other b/g	1.03E-04	BA 2		
Eu 154	2.15E-07	BB 2			<b>Total a</b>	<b>-7.43E-05</b>	<b>CC 2</b>		<b>0</b>
Eu 155	1.88E-08	BB 2			<b>Total b/g</b>	<b>-1.88E-01</b>	<b>BB 2</b>		<b>0</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