

WASTE STREAM	2D08.4	MSSS Compartment 4
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SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Ltd

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025			
Future arisings:	~ 599.0			
Total future arisings:	0.0			
Total waste volume:	599.0			

Number of waste packages in stock: At 1.4.2025..... - packages

Comment on arising rates: There are no further arisings to this waste stream.

Additional information on quantities: Waste volume includes swarf/sludge, miscellaneous beta/gamma and aggregate. Waste volumes are estimates derived from known fuel decanning campaigns and storage volumes.

Uncertainty factors on volumes:

Stock (upper):	x 1.50	Arisings (upper):	x -
Stock (lower):	x 0.66	Arisings (lower):	x -

WASTE SOURCE Swarf from Magnox decanning. Other miscellaneous beta/gamma wastes from Windscale and other sites.

PHYSICAL CHARACTERISTICS

General description: Magnox cladding, much of which has been converted to a magnesium hydroxide sludge. Some miscellaneous beta/gamma wastes (MBGW) are also present: these include tins/cans, filters, tools, pipework, pumps, valves, plastic items. The waste also includes some uranium most of which has corroded to oxides of uranium. A small volume of limestone aggregate is present at the bottom of the compartment.

Changes since waste generated: Swarf from Magnox decanning has reacted with the storage cover water to form corrosion products. Some degradation of miscellaneous components waste will have occurred.

Bulk density (t/m³): = 1.7

Comment on density: Bulk density is solids only - includes water content based on assumptions of draining characteristics. Bulk density including interstitial liquor = 1.83t/m³, bulk density with cover liquor and interstitial liquor = 1.80t/m³. Average decanning debris is ~1.6t/m³ and average MBGW is ~3.2t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Magnox swarf (1.78%), Magnox sludge (21.46%), Al/Al(OH)₃ (1.91%), U/UO₂/U₃O₈ (1.53%), MBGW (scrap, filters, cans, etc) (50.69%), aggregate (limestone) (1.13%), water (21.28%), others (0.23%). Includes interstitial liquor and cover liquor.

Chemical state: Neutral

Sheet metal proportion / thickness: No significant quantities of sheet metal, although small quantities of fabricated items are present, e.g. paint tins, HEPA filters. Small pieces of fin Magnox metal present.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 8.9	Mainly SS316 and SS304.	
Other ferrous metals.....	~ 26.8	Carbon steels.	
Iron.....	P	-	
Aluminium.....	~ 1.9	-	
Beryllium.....	NE	-	
Cobalt.....	P	-	
Copper.....	TR	-	
Lead.....	P	-	
Magnox/Magnesium.....	~ 1.8	Predominantly Magnox.	
Nickel.....	NE	-	
Titanium.....	NE	-	
Uranium.....	~ 0.62	-	
Zinc.....	TR	-	
Zircaloy/Zirconium.....	~ 0.02	-	
Other metals.....	~ 0.02	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	~ 6.0	-	
Paper, cotton.....		-	
Wood.....		-	
Halogenated plastics.....	~ 1.1	-	
Total non-halogenated plastics.....	~ 1.1	-	
Condensation polymers.....		-	
Others.....		-	
Organic ion exchange materials.....		-	
Total rubber.....	TR	-	
Halogenated rubber.....		-	
Non-halogenated rubber.....		-	
Hydrocarbons.....		-	
Oil or grease.....	< 0.01	-	
Fuel.....	NE	-	
Asphalt/Tarmac (cont.coal tar).....	NE	-	
Asphalt/Tarmac (no coal tar).....	NE	-	
Bitumen.....	NE	-	
Others.....	NE	-	
Other organics.....	~ 0.37	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	NE	-	
Inorganic sludges and flocs.....	~ 22.0	-	
Soil.....	NE	-	
Brick/Stone/Rubble.....	~ 1.1	-	
Cementitious material.....	NE	-	
Sand.....	NE	-	
Glass/Ceramics.....	~ 0.17	-	
Graphite.....	~ 2.1	-	
Desiccants/Catalysts.....	NE	-	
Asbestos.....	NE	-	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
Free aqueous liquids.....	~ 20.9	Includes interstitial liquor and cover liquor. Total waste volume 617 m³ with cover liquor.	
Free non-aqueous liquids.....	NE	-	
Powder/Ash.....	NE	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	TR	-
Chloride.....	~ 0.05	Alkali metal and alkaline earth chlorides.
Iodide.....	TR	-
Cyanide.....	NE	-
Carbonate.....	TR	-
Nitrate.....	TR	-
Nitrite.....	TR	-
Phosphate.....	TR	-
Sulphate.....	TR	-
Sulphide.....	TR	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	= 0	-
Low flash point liquids.....	= 0	-
Explosive materials.....	= 0	-
Phosphorus.....	= 0	-
Hydrides.....	P	Trace, passivated.
Biological etc. materials.....	= 0	-
Biodegradable materials.....	P	-
Putrescible wastes.....	P	Cellulosics.
Non-putrescible wastes.....	P	Organics - plastics and rubbers.
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	P	<5%
Higher activity particles.....	P	Radioactive sludges and solids.
Soluble solids as bulk chemical compounds.....	P	Elemental and hydroxides, oxides and carbonates.

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	= 0	-
Benzene.....		-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....	= 0	-
Phenol.....		-
Styrene.....		-
Tri-butyl phosphate.....		-
Other organophosphates.....	= 0	-
Vinyl chloride.....		-
Arsenic.....		-
Barium.....		-
Boron.....	NE	Traces - elemental and borates.
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	= 0	-
Caesium.....		-
Selenium.....		-
Chromium.....		P In steels.
Molybdenum.....	P	In steels.
Thallium.....		-
Tin.....	P	Traces.
Vanadium.....		In steels.
Mercury compounds.....	-	-
Others.....	NE	-

Complexing agents (%wt):

No		
	(%wt)	Type(s) and comment
EDTA.....		-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....		-
Other organic complexants.....		-
Total complexing agents.....		-

Physical components:

	Number	Type(s) and comment
Sources.....		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1.....		-
EEE Type 2.....		-
EEE Type 3.....		-
EEE Type 4.....		-
EEE Type 5.....		-

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off-site	Stream volume %
Size reduction		100.0
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application		
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		

Comments on planned treatments:

-

Conditioning method:

The waste will be retrieved from MSSS and stored in an unconditioned state for a period of 70 years. Following the period of storage, it will be retrieved (from storage) and conditioned for ultimate disposal to the GDF.

Conditioning plants:

Plant Name	Location
Magnox Swarf Storage Silo (MSSS) Final Conditioning Plant	Sellafield

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

5:1 GGBS/CEM 1

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	Sellafield enhanced 3 m³ box	100.0	0.68	2.2	886	-

Range in container waste loading: There will be considerable variability in unconditioned waste volume per package due to variations in skip loading and content. The actual number of packages produced is identified in the Sellafield Decommissioning Product and Secondary Waste Plan.
886 Boxes = 845 Boxes plus 41 from residuals.

Other information on packaging and conditioning: Waste matrix (as retrieved) will be in-filled with grout. A second pour of capping grout will be added. Void spaces between Skip wall and Box wall will be filled with grout.

Conditioned density (t/m³): ~ 2.0
Conditioned density comment: Density of conditioned waste will be fairly uniform.

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	100.0		
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: Irradiated fuel, fuel components, reactor components and miscellaneous items contaminated with fuel residues.

Uncertainty: Accuracy is generally good for fuel based residues, based on decanning records arisings and fuel carry over evaluations. For miscellaneous waste items, where records are incomplete, the accuracy is worse.

Measurement of radioactivities: Isotopic specific activity (TBq/m³) is derived by dividing the estimated total activity of the isotope by the total volume of the waste.

Chemical form of radionuclides:

- H-3: Present in elemental and reacted forms.
- C-14: Present in elemental and reacted forms.
- Cl-36: Present in elemental and reacted forms.
- Se-79: Present in elemental and reacted forms.
- Tc-99: Present in elemental and reacted forms.
- I-129: Present in elemental and reacted forms.
- Ra: Present in elemental forms.
- Th: Present in elemental and reacted forms.
- U: Present in metallic and reacted forms (oxides and possibly hydride).
- Np: Present in elemental and reacted forms.
- Pu: Present in metallic and mixed oxide forms.

WASTE STREAM			2D08.4		MSSS Compartment 4				
Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	1.25E-02	A B 2			Gd 153	1.17E-30	A A 2		
Be 10	1.10E-07	A A 2			Ho 163	4.57E-12	A A 2		
C 14	6.70E-02	A B 2			Ho 166m	2.47E-08	A A 2		
Na 22					Tm 170				
Al 26					Tm 171	2.08E-14	A A 2		
Cl 36	7.18E-07	A B 2			Lu 174				
Ar 39	2.22E-05	A B 2			Lu 176				
Ar 42					Hf 178n				
K 40	4.56E-09	A B 2			Hf 182	8.99E-17	A A 2		
Ca 41	4.80E-05	A B 2			Pt 193				
Mn 53	1.10E-12	A B 2			Tl 204	6.11E-07	A A 2		
Mn 54					Pb 205	1.58E-09	A A 2		
Fe 55	1.97E-05	A A 2			Pb 210	9.36E-10	A A 2		
Co 60	1.93E-03	A A 2			Bi 208				
Ni 59	1.30E-02	A A 2			Bi 210m	1.08E-13	A A 2		
Ni 63	1.08E+00	A A 2			Po 210	9.14E-10	A A 2		
Zn 65					Ra 223	8.17E-09	A A 2		
Se 79	5.25E-06	A A 2			Ra 225	2.41E-11	A A 2		
Kr 81					Ra 226	2.24E-09	A A 2		
Kr 85	2.15E-02	A A 2			Ra 228	3.84E-13			
Rb 87	1.29E-10	A A 2			Ac 227	8.19E-09	A A 2		
Sr 90	1.76E+00	A A 2			Th 227	8.06E-09	A A 2		
Zr 93	1.68E-04	A A 2			Th 228	9.31E-08	A A 2		
Nb 91					Th 229	2.41E-11	A A 2		
Nb 92	5.35E-16	A A 2			Th 230	1.71E-07	A A 2		
Nb 93m	1.65E-04	A A 2			Th 232	1.27E-12	A A 2		
Nb 94	1.12E-04	A A 2			Th 234	3.32E-04	A A 2		
Mo 93	6.31E-06	A A 2			Pa 231	1.43E-08	A A 2		
Tc 97					Pa 233	9.78E-06	A A 2		
Tc 99	1.31E-03	A B 2			U 232	9.04E-08	A A 2		
Ru 106	1.65E-16	A A 2			U 233	5.26E-09	A A 2		
Pd 107	7.60E-06	A A 2			U 234	3.06E-04	A A 2		
Ag 108m	1.11E-09	A A 2			U 235	1.04E-05	A A 2		
Ag 110m	1.28E-27	A A 2			U 236	2.42E-05	A A 2		
Cd 109	1.11E-19	A A 2			U 238	3.32E-04	A A 2		
Cd 113m	9.62E-06	A A 2			Np 237	9.78E-06	A A 2		
Sn 119m					Pu 236	3.34E-12	A A 2		
Sn 121m	3.04E-07	A A 2			Pu 238	1.24E-02	A A 2		
Sn 123					Pu 239	1.15E-01	A A 2		
Sn 126	6.03E-05	A A 2			Pu 240	8.23E-02	A A 2		
Sb 125	4.06E-07	A A 2			Pu 241	4.06E-01	A A 2		
Sb 126	8.44E-06	A A 2			Pu 242	2.62E-05	A A 2		
Te 125m	1.02E-07	A A 2			Am 241	2.01E-01	A A 2		
Te 127m					Am 242m	1.44E-04	A A 2		
I 129	2.73E-06	A B 2			Am 243	4.79E-05	A A 2		
Cs 134	7.34E-09	A A 2			Cm 242	1.19E-04	A A 2		
Cs 135	6.96E-05	A A 2			Cm 243	1.20E-05	A A 2		
Cs 137	2.42E+00	A B 2			Cm 244	2.06E-04	A A 2		
Ba 133	1.43E-11	A A 2			Cm 245	8.58E-08	A A 2		
La 137					Cm 246	1.19E-08	A A 2		
La 138	6.49E-15	A A 2		Cm 248	9.20E-25				
Ce 144	3.92E-21	A A 2		Cf 249	9.90E-14	A A 2			
Pm 145				Cf 250	2.96E-14	A A 2			
Pm 147	5.36E-06	A A 2		Cf 251	2.51E-15	A A 2			
Sm 147	1.60E-16			Cf 252	1.02E-19	A A 2			
Sm 151	3.75E-02	A A 2		Unsp a	1.15E-01				
Eu 152	5.62E-05	A A 2		Unsp b/g	4.34E+00				
Eu 154	1.33E-03	A A 2		Total a	5.28E-01	*	0	*	
Eu 155	6.19E-05	A A 2		Total b/g	1.02E+01	*	0	*	

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 the 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
* Total calculated from the 114 declared radionuclides