

WASTE STREAM	2D24.1	MSSS Compartment 16
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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:	~ 373.0			
Total future arisings:	0.0			
Total waste volume:	373.0			

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

Comment on arising rates: There are no future arisings.

Additional information on quantities: Waste volume includes volume of 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 Wastes associated with Magnox fuel decanning and off-site processes (mainly CX) and their subsequent underwater storage.

PHYSICAL CHARACTERISTICS

General description: The waste is debris from the process of decanning Magnox reactor fuel elements plus some waste (predominantly aluminium, with some Magnox) contained in buckets (mild steel and aluminium) from Chapelcross. The waste is stored under water. The waste includes pieces of Magnox cans, fins and all other fuel element components, including fuel; additionally aluminium from CX. Magnox components are corroded by the storage water, and partially converted to magnesium hydroxide as a fixed surface layer and a loose sludge. Fuel is similarly corroded to oxides of uranium. Current evidence is that aluminium components have not corroded (due to the in-silo environment).

Changes since waste generated: Swarf and uranium from Magnox decanning have reacted with storage cover water to form corrosion products. Current information is that aluminium (predominantly from CX) has not reacted, due to in-Silo conditions.

Bulk density (t/m³): ~ 0.89

Comment on density: Bulk density is solids only - includes water content based on assumptions of draining characteristics. Bulk density including interstitial liquor = 1.48t/m³, bulk density with cover liquor and interstitial liquor = 1.42t/m³. Average decanning debris is ~1.6t/m³ and average MBGW is ~3.2t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Magnox swarf (14.61%), Magnox sludge (22.58%), Al₂O₃ (0%), UO₂/U₃O₈ (9.46%), MBGW (scrap, filters, cans, etc.) (7.65%), aggregate (limestone) (0%), water (45.17%), others (0.53%). Includes interstitial liquor and cover liquor. Total volume including cover liquor is 427 m³.

Chemical state: Neutral

Sheet metal proportion / thickness: No significant quantities of sheet metal, although fabricated items are present, e.g. Chapelcross buckets, together with small quantities of miscellaneous items of decanner waste, such as HEPA filters are present. Pieces of Magnox metal and aluminium are present.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 0.66	Mainly SS316 and SS304.	
Other ferrous metals.....	~ 3.0	Carbon steels.	
Iron.....	NE	-	
Aluminium.....	~ 0.09	-	
Beryllium.....	NE	-	
Cobalt.....	NE	-	
Copper.....	NE	-	
Lead.....	NE	-	
Magnox/Magnesium.....	~ 17.0	Predominantly Magnox.	
Nickel.....	NE	-	
Titanium.....	NE	-	
Uranium.....	~ 6.0	-	
Zinc.....	NE	-	
Zircaloy/Zirconium.....	~ 0.04	-	
Other metals.....	~ 0.05	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	~ 0.08	-	
Paper, cotton.....	-	-	
Wood.....	-	-	
Halogenated plastics.....	~ 0.06	-	
Total non-halogenated plastics.....	~ 0.03	-	
Condensation polymers.....	-	-	
Others.....	-	-	
Organic ion exchange materials.....	NE	-	
Total rubber.....	NE	-	
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.....	~ 0.01	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	NE	-	
Inorganic sludges and flocs.....	~ 24.2	-	
Soil.....	NE	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	NE	-	
Sand.....	NE	-	
Glass/Ceramics.....	~ 0.36	-	
Graphite.....	~ 0.04	-	
Desiccants/Catalysts.....	NE	-	
Asbestos.....	NE	-	
Non/low friable.....	-	-	
Moderately friable.....	-	-	
Highly friable.....	-	-	
Free aqueous liquids.....	~ 42.5	Includes interstitial liquor and cover liquor. Total volume including cover liquor is 427 m3.	
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.....	TR	-
Iodide.....	TR	-
Cyanide.....	NE	-
Carbonate.....	P	-
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.....		
Putrescible wastes.....	P	Cellulosics.
Non-putrescible wastes.....	P	Organics - plastics and rubbers.
Corrosive materials.....	= 0	-
Pyrophoric materials.....	P	-
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.....		-
Benzene.....	= 0	-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....		-
Phenol.....	= 0	-
Styrene.....		-
Tri-butyl phosphate.....	= 0	-
Other organophosphates.....		-
Vinyl chloride.....	P	-
Arsenic.....	= 0	-
Barium.....		-
Boron.....	NE	Traces - elemental and borates.
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	= 0	-
Caesium.....		-
Selenium.....	= 0	-
Chromium.....	P	In steels.
Molybdenum.....	P	In steels.
Thallium.....		-
Tin.....	P	Traces.
Vanadium.....	P	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 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		100.0

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

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	0.85	2.2	438	-

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.
438 Boxes = 392 Boxes plus 46 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, and materials from isotope handling operations.

Uncertainty: Accuracy is generally good - based on decanning records arisings and fuel carry over evaluations.

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.

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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	4.05E-02	A B 2			Gd 153	8.49E-21	A A 2		
Be 10	4.20E-07	A A 2			Ho 163	5.20E-11	A A 2		
C 14	7.20E-03	A B 2			Ho 166m	4.64E-07	A A 2		
Na 22					Tm 170	1.66E-38	A A 2		
Al 26					Tm 171	1.52E-10	A A 2		
Cl 36	1.55E-08	A B 2			Lu 174				
Ar 39	3.24E-07	A B 2			Lu 176				
Ar 42					Hf 178n				
K 40	1.66E-08	A B 2			Hf 182	1.10E-15	A A 2		
Ca 41	1.79E-04	A B 2			Pt 193				
Mn 53	4.96E-12	A B 2			Tl 204	2.20E-07	A A 2		
Mn 54					Pb 205				
Fe 55	1.58E-04	A A 2			Pb 210	2.26E-09	A A 2		
Co 60	4.31E-02	A A 2			Bi 208				
Ni 59	6.69E-03	A A 2			Bi 210m	1.13E-22	A A 2		
Ni 63	6.29E-01	A A 2			Po 210	2.19E-09	A A 2		
Zn 65					Ra 223	2.81E-08	A A 2		
Se 79	4.62E-05	A A 2			Ra 225	6.31E-11	A A 2		
Kr 81					Ra 226	6.55E-09	A A 2		
Kr 85	5.26E-01	A A 2			Ra 228	1.19E-13			
Rb 87	1.30E-12	A A 2			Ac 227	2.82E-08	A A 2		
Sr 90	2.16E+01	A A 2			Th 227	2.77E-08	A A 2		
Zr 93	1.44E-03	A A 2			Th 228	1.62E-06	A A 2		
Nb 91					Th 229	6.32E-11	A A 2		
Nb 92	6.02E-15	A A 2			Th 230	6.67E-07	A A 2		
Nb 93m	1.21E-03	A A 2			Th 232	4.05E-13	A A 2		
Nb 94	1.16E-07	A A 2			Th 234	1.82E-03	A A 2		
Mo 93	4.15E-06	A A 2			Pa 231	5.33E-08	A A 2		
Tc 97					Pa 233	9.35E-05	A A 2		
Tc 99	1.17E-02	A B 2			U 232	1.58E-06	A A 2		
Ru 106	5.25E-10	A A 2			U 233	1.97E-08	A A 2		
Pd 107	8.40E-05	A A 2			U 234	1.60E-03	A A 2		
Ag 108m	1.29E-08	A A 2			U 235	4.41E-05	A A 2		
Ag 110m	4.48E-18	A A 2			U 236	1.89E-04	A A 2		
Cd 109	1.63E-17	A A 2			U 238	1.82E-03	A A 2		
Cd 113m	6.06E-08	A A 2			Np 237	9.36E-05	A A 2		
Sn 119m					Pu 236	1.25E-09	A A 2		
Sn 121m	1.44E-07	A A 2			Pu 238	2.64E-01	A A 2		
Sn 123					Pu 239	7.48E-01	A A 2		
Sn 126	6.20E-04	A A 2			Pu 240	8.55E-01	A A 2		
Sb 125	3.39E-04	A A 2			Pu 241	1.11E+01	A A 2		
Sb 126	8.68E-05	A A 2			Pu 242	4.99E-04	A A 2		
Te 125m	8.49E-05	A A 2			Am 241	2.34E+00	A A 2		
Te 127m					Am 242m	3.36E-03	A A 2		
I 129	2.56E-05	A B 2			Am 243	1.08E-03	A A 2		
Cs 134	3.66E-05	A A 2			Cm 242	2.77E-03	A A 2		
Cs 135	6.17E-04	A A 2			Cm 243	4.45E-04	A A 2		
Cs 137	3.18E+01	A B 2			Cm 244	5.75E-03	A A 2		
Ba 133	4.79E-10	A A 2			Cm 245	6.26E-07	A A 2		
La 137					Cm 246	4.41E-08	A A 2		
La 138	7.78E-14	A A 2			Cm 248	4.65E-24			
Ce 144	4.93E-13	A A 2			Cf 249	2.94E-14	A A 2		
Pm 145					Cf 250	1.20E-14	A A 2		
Pm 147	4.24E-03	A A 2			Cf 251	2.52E-16	A A 2		
Sm 147	1.27E-13				Cf 252	5.16E-19	A A 2		
Sm 151	2.75E-01	A A 2			Unsp a	7.51E-01			
Eu 152	1.32E-03	A A 2			Unsp b/g	5.55E+01			
Eu 154	7.74E-02	A A 2			Total a	4.97E+00	*	0	*
Eu 155	5.52E-03	A A 2			Total b/g	1.22E+02	*	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