

WASTE STREAM	2D35/C	Encapsulated Retrieved Magnox Cladding
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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		1209.3	1414.9
Future arisings:				0.0
Total future arisings:			0.0	0.0
Total waste volume:			1209.3	1414.9

Number of waste packages in stock: At 1.4.2025..... 2478 packages

Comment on arising rates: There will be no future arisings of retrieved swarf from Compartments 19-22.

Additional information on quantities: The total volume of encapsulated retrieved swarf is 1209.26 cubic metres. Operations to retrieve additional swarf from Compartments 19-22 are not planned. Number of drums in stock is known precisely. It is likely that one drum included in this total is not an MSSS drum.

Uncertainty factors on volumes: Stock (upper): x 1.00 Arisings (upper): x -
Stock (lower): x 1.00 Arisings (lower): x -

WASTE SOURCE Magnox swarf from retrieval at Magnox Swarf Storage Silo encapsulated with grout in 500 litre stainless steel drums.

PHYSICAL CHARACTERISTICS

General description: The waste is swarf from Magnox fuel decanning. The waste is encapsulated in a grout matrix comprising ground granulated Blast Furnace Slag and Ordinary Portland Cement. No items require special handling.

Changes since waste generated: The waste has been encapsulated in grout and is stored in 500 litre drums.

Bulk density (t/m³): = 1.9

Comment on density: -

CHEMICAL COMPOSITION

General description and components (%wt): (a) Cement grout matrix, which comprises 82% by weight of the waste, is composed of ground granulated blast furnace slag (57.4%), ordinary Portland cement (16.7%), and water (25.9%). (b) Encapsulated waste, which comprises 16.5% by weight of the waste, is composed of Magnox alloy (94.6%), aluminium (1.5%), stainless steel (0.15%), nimonic (0.2%), uranium (3.5%). (c) Anti-flotation plate, which comprises 1.5% by weight of the waste, is composed of mild steel.

Chemical state: Alkali

Sheet metal proportion / thickness: There is no sheet metal. The metal content of the waste varies in form depending on the extent of corrosion, with individual pieces of Magnox being typically 100mm long and 10mm wide.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0	-	100.0
Other ferrous metals.....	= 1.0	Mild steel, carbon steel.	
Iron.....	0	-	
Aluminium.....	= 0.25	-	
Beryllium.....	< 0.01	-	
Cobalt.....	= 0	-	
Copper.....	-	-	
Lead.....	-	-	
Magnox/Magnesium.....	= 15.1	-	
Nickel.....	~ 0.05	-	
Titanium.....	TR 0	-	
Uranium.....	1.4	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	~ 0.10	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	= 0	-	
Paper, cotton.....	= 0	-	
Wood.....	= 0	-	
Halogenated plastics.....	= 0	-	
Total non-halogenated plastics.....	TR	-	
Condensation polymers.....	TR	-	
Others.....	TR	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	= 0	-	
Halogenated rubber.....	= 0	-	
Non-halogenated rubber.....	TR	-	
Hydrocarbons.....	0	-	
Oil or grease.....	0	-	
Fuel.....	0	-	
Asphalt/Tarmac (cont.coal tar).....	0	-	
Asphalt/Tarmac (no coal tar).....	0	-	
Bitumen.....	0	-	
Others.....	0	-	
Other organics.....	= 0	-	

Other materials (%wt):

	(%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.....	~ 82.1	-	
Sand.....	= 0	No sand is added to the grout mix.	
Glass/Ceramics.....	= 0	-	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	= 0	-	
Asbestos.....	= 0	No known asbestos content.	
Non/low friable.....	0	-	
Moderately friable.....	0	-	
Highly friable.....	0	-	
Free aqueous liquids.....	= 0	-	
Free non-aqueous liquids.....	= 0	-	
Powder/Ash.....	= 0	-	

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	= 0	-
Chloride.....	< 0.05	-
Iodide.....	TR	-
Cyanide.....	NE	-
Carbonate.....	TR	-
Nitrate.....	= 0	-
Nitrite.....	TR	-
Phosphate.....	= 0	-
Sulphate.....	< 0.50	-
Sulphide.....	< 0.95	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	= 15.1	Magnox swarf considered as combustible.
Low flash point liquids.....	= 0	-
Explosive materials.....	= 0	-
Phosphorus.....	= 0	-
Hydrides.....	P	Trace amount of uranium hydride may be present.
Biological etc. materials.....	= 0	-
Biodegradable materials.....	= 0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....	= 0	-
Corrosive materials.....	P	Cement grout is strongly alkaline.
Pyrophoric materials.....	P	Present only in trace amounts.
Generating toxic gases.....	P	Chronic low level evolution of hydrogen.
Reacting with water.....	= 0	-
Higher activity particles.....	P	Small fraction only released in the event of a drop.
Soluble solids as bulk chemical compounds.....	P	Various sodium and magnesium compounds.

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	0	-
Benzene.....	= 0	-
Chlorinated solvents.....	0	-
Formaldehyde.....	0	-
Organometallics.....	0	-
Phenol.....	= 0	-
Styrene.....	0	-
Tri-butyl phosphate.....	= 0	-
Other organophosphates.....	0	-
Vinyl chloride.....	= 0	-
Arsenic.....	= 0	-
Barium.....	0	-
Boron.....	= 0	-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	= 0	-
Caesium.....	0	-
Selenium.....	= 0	-
Chromium.....	P	Small amounts present in OPC cement.
Molybdenum.....	= 0	-
Thallium.....	0	-
Tin.....	P	Trace amounts.
Vanadium.....	= 0	-
Mercury compounds.....	0	-
Others.....	= 0	-

Complexing agents (%wt):

No		
	(%wt)	Type(s) and comment
EDTA.....	0	-
DPTA.....	0	-
NTA.....	0	-
Polycarboxylic acids.....	= 0	-
Other organic complexants.....		There are no complexing agents present in the waste.
Total complexing agents.....	= 0	-

Physical components:

	Number	Type(s) and comment
Sources.....	= 0	-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1.....	0	-
EEE Type 2.....	0	-
EEE Type 3.....	0	-
EEE Type 4.....	0	-
EEE Type 5.....	0	-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction	On-site	= 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:

Encapsulation in grout at Magnox Encapsulation Plant

Conditioning plants:

Plant Name	Location
Magnox Encapsulation Plant (MEP)	Sellafield

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix: BFS/OPC
7:3 to 9:1 (3.44:1)
0.33:1-0.37:1 (0.35:1) w/s

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	500 l drum	100.0	0.49	0.49	2478	-

Range in container waste loading:

Other information on packaging and conditioning: N/A

Conditioned density (t/m³): = 1.9
Conditioned density comment: -

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: Mixed fission products and reactor fuel carry-over. The main sources of activity are Ce-144, Pm-147, Ru-106, Nb-95, Zr-95, Cs-137 in proportions typical for outer layer of irradiated uranium fuel rods.

Uncertainty: Activities are derived best estimates within a factor of 3, and assume an average 1% fuel carry over.

Measurement of radioactivities: -

Chemical form of radionuclides: H-3: -
C-14: -
Cl-36: Present as trace amount of clathrate compounds of metallic salts readily lost to aqueous solution.

Se-79: -
Tc-99: -
I-129: Present as trace amount of clathrate compounds of metallic salts readily lost to aqueous solution.

Ra: -
Th: -
U: Present as metal carry-over from the decanning process, with trace quantities of hydride and small amounts of oxide.
Np: -
Pu: Associated with the uranium.

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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	8.74E-03	B B 2			Gd 153				
Be 10	8.85E-08	B B 2			Ho 163				
C 14	4.03E-03	B B 2			Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36	1.67E-05	C B 2			Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41	1.30E-04	B B 2			Pt 193				
Mn 53			Tl 204						
Mn 54	1.87E-14	B B 2	Pb 205						
Fe 55	2.52E-04	B B 2	Pb 210	2.38E-10	B B 2				
Co 60	4.67E-02	B B 2	Bi 208						
Ni 59	4.84E-03	B B 2	Bi 210m						
Ni 63	4.40E-01	B B 2	Po 210	2.30E-10	B B 2				
Zn 65	3.42E-17	B B 2	Ra 223	3.14E-09	B B 2				
Se 79	7.31E-06	B B 2	Ra 225	7.18E-12	B B 2				
Kr 81			Ra 226	7.73E-10	B B 2				
Kr 85			Ra 228	4.17E-14	B B 2				
Rb 87			Ac 227	3.16E-09	B B 2				
Sr 90	4.09E+00	B B 2	Th 227	3.11E-09	B B 2				
Zr 93	2.65E-04	B B 2	Th 228	3.75E-14	B B 2				
Nb 91			Th 229	7.20E-12	B B 2				
Nb 92			Th 230	8.91E-08	B B 2				
Nb 93m	1.80E-04	B B 2	Th 232	5.42E-14	B B 2				
Nb 94	1.55E-07	B B 2	Th 234	2.64E-04	B B 2				
Mo 93	2.98E-06	B B 2	Pa 231	6.88E-09	B B 2				
Tc 97			Pa 233	1.70E-05	B B 2				
Tc 99	2.17E-03	B B 2	U 232						
Ru 106	9.03E-10	B B 2	U 233	2.82E-09	B B 2				
Pd 107	1.91E-05	B B 2	U 234	2.34E-04	B B 2				
Ag 108m	9.53E-11	B B 2	U 235	5.70E-06	B B 2				
Ag 110m			U 236	3.04E-05	B B 2				
Cd 109			U 238	2.64E-04	B B 2				
Cd 113m			Np 237	1.70E-05	B B 2				
Sn 119m			Pu 236						
Sn 121m	7.79E-06	B B 2	Pu 238	6.50E-02	B B 2				
Sn 123			Pu 239	1.49E-01	B B 2				
Sn 126	5.74E-05	B B 2	Pu 240	1.90E-01	B B 2				
Sb 125			Pu 241	3.51E+00	B B 2				
Sb 126	8.04E-06	B B 2	Pu 242	1.46E-04	B B 2				
Te 125m			Am 241	5.86E-01	B B 2				
Te 127m			Am 242m	9.23E-04	B B 2				
I 129	4.53E-06	B B 2	Am 243	3.27E-04	B B 2				
Cs 134	2.51E-05	B B 2	Cm 242	7.62E-04	B B 2				
Cs 135	1.10E-04	B B 2	Cm 243	1.58E-04	B B 2				
Cs 137	6.44E+00	B B 2	Cm 244	2.09E-03	B B 2				
Ba 133			Cm 245	1.83E-07	B B 2				
La 137			Cm 246	1.54E-08	B B 2				
La 138			Cm 248						
Ce 144	1.09E-12	B B 2	Cf 249						
Pm 145			Cf 250						
Pm 147	1.99E-03	B B 2	Cf 251						
Sm 147	6.21E-11	B B 2	Cf 252						
Sm 151	4.48E-02	B B 2	Unsp a	6.00E-07	B B 2				
Eu 152	2.03E-04	B B 2	Unsp b/g	2.02E+01	B B 2				
Eu 154	2.13E-02	B B 2	Total a	9.94E-01	*		0	*	
Eu 155	2.36E-03	B B 2	Total b/g	3.48E+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