

WASTE STREAM	2F10/C	Encapsulated Centrifuge Cake
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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		476.2	576.1
Future arisings:	1.4.2025 - 31.3.2026		66.1	79.9
	1.4.2026 - 31.3.2027		34.5	41.7
	1.4.2027 - 31.3.2028		33.0	40.0
Total future arisings:			133.6	161.6
Total waste volume:			609.8	737.7

Number of waste packages in stock: At 1.4.2025..... 1009 packages

Comment on arising rates: -

Additional information on quantities: Known stocks.

Uncertainty factors on volumes:

Stock (upper):	x 1.00	Arisings (upper):	x 1.50
Stock (lower):	x 1.00	Arisings (lower):	x 1.00

WASTE SOURCE Slurry arising from reprocessing operations in THORP.

PHYSICAL CHARACTERISTICS

General description: The waste is slurry comprised of centrifuge cake. This waste is then encapsulated in grout. No items require special handling.

Changes since waste generated: This waste stream does not undergo any physical or chemical change prior to conditioning.

Bulk density (t/m³): ~ 1.8

Comment on density: Density of conditioned waste. Raw waste density ~1.0 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Water (28.8%), insoluble fission products (1.2%) and grout (70%). Minor components of the slurry include insoluble plutonium, crud, fuel (in solution), Zircaloy fines, stainless steel fines.

Chemical state: Alkali

Sheet metal proportion / thickness: There is no sheet or bulk metal present.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0.50	-	
Other ferrous metals.....	= 0.10	-	
Iron.....	-	-	
Aluminium.....	= 0	-	
Beryllium.....	< 0.01	-	
Cobalt.....	= 0	-	
Copper.....	= 0	-	
Lead.....	-	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	= 0	-	
Titanium.....	NE	-	
Uranium.....	= 0.20	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0.40	-	
Other metals.....	= 0	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 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):

	(%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.....	= 98.8	Includes centrifuge cake carrier liquor.	
Sand.....	= 0	No added sand in encapsulation grout.	
Glass/Ceramics.....	= 0	-	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	= 0	-	
Asbestos.....	= 0	No asbestos present.	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
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	-
Iodide.....	= 0	-
Cyanide.....	= 0	-
Carbonate.....	= 0	-
Nitrate.....	P	-
Nitrite.....	= 0	-
Phosphate.....	= 0	-
Sulphate.....	= 0	-
Sulphide.....	= 0	-

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.....		-
Biological etc. materials.....	= 0	-
Biodegradable materials.....	= 0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....	= 0	-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	= 0	-
Higher activity particles.....	P	Small fraction bound by encapsulation grout.
Soluble solids as bulk chemical compounds.....	P	Some soluble calcium compounds.

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.....	= 0	-
Arsenic.....	= 0	-
Barium.....		-
Boron.....	= 0	-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	= 0	-
Caesium.....		-
Selenium.....	= 0	-
Chromium.....	P	Small amount in encapsulation grout.
Molybdenum.....	= 0	-
Thallium.....		-
Tin.....	P	Trace amount in encapsulation grout.
Vanadium.....	= 0	-
Mercury compounds.....		-
Others.....	= 0	-

Complexing agents (%wt):

No		
	(%wt)	Type(s) and comment
EDTA.....		-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....	= 0	-
Other organic complexants.....	= 0	No organic or inorganic complexing agents are present.
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:

Encapsulation

Conditioning method:

In-drum mix in Waste Encapsulation Plant

Conditioning plants:

Plant Name	Location
Wastes Encapsulation Plant (WEP)	Sellafield

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

9:1 BFS/OPC powder blend.
2.8kg/litre (cement powder to litre of slurry).
Centrifuge cake is conditioned with lime to reduce molarity prior to encapsulation.

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	0.47	0.47	1292	-

Range in container waste loading:

Other information on packaging and conditioning: Waste is already conditioned.

Conditioned density (t/m³): = 1.8
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		2077
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: The waste will contain insoluble fission products, insoluble plutonium and fuel in solution.

Uncertainty: -

Measurement of radioactivities: The activities are a combination of measurements and calculated activities, based on characteristics of fuel reprocessed to date for stocks and that still to be reprocessed for arisings.

Chemical form of radionuclides: H-3: Not estimated.
C-14: Not estimated.
Cl-36: Present in trace amounts as clathrate compounds of metallic salts readily lost to aqueous solution.

Se-79: Not estimated.
Tc-99: Not estimated.
I-129: Present in trace amounts as clathrate compounds of metallic salts readily lost to aqueous solution.

Ra: Not estimated.
Th: Not estimated.
U: UO2.
Np: Not estimated.
Pu: PuO2.

WASTE STREAM		2F10/C		Encapsulated Centrifuge Cake					
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	3.96E-03	B B 1	6.71E-03	B B 1	Gd 153	2.88E-09	B B 2	3.46E-08	B B 2
Be 10	4.91E-09	B B 2	5.27E-09	B B 2	Ho 163	1.22E-12	B B 2	1.31E-12	B B 2
C 14	9.07E-06	B B 2	8.99E-06	B B 2	Ho 166m	7.85E-08	B B 2	9.23E-08	B B 2
Na 22					Tm 170	1.02E-15	B B 2	2.21E-14	B B 2
Al 26					Tm 171	8.93E-08	B B 2	4.45E-07	B B 2
Cl 36	1.02E-03	B B 2	1.02E-03	B B 2	Lu 174				8
Ar 39	1.50E-09	B B 2	1.40E-09	B B 2	Lu 176	1.33E-18	B B 2	1.00E-18	B B 2
Ar 42				8	Hf 178n				8
K 40	2.63E-12	B B 2	2.39E-12	B B 2	Hf 182	4.86E-17	B B 2	5.30E-17	B B 2
Ca 41	3.97E-08	B B 2	3.57E-08	B B 2	Pt 193				8
Mn 53	1.50E-15	B B 2	1.37E-15	B B 2	Tl 204				8
Mn 54	2.38E-07	B B 2	2.26E-06	B B 2	Pb 205				5
Fe 55	2.49E-01	B B 1	9.72E-01	B B 1	Pb 210	7.70E-08	B B 2	2.93E-12	B B 2
Co 60	2.56E-01	B B 1	6.61E-01	B B 1	Bi 208				8
Ni 59	9.42E-06	B B 2	1.19E-05	B B 2	Bi 210m				5
Ni 63	1.86E-01	B B 1	2.15E-01	B B 1	Po 210	7.33E-08	B B 2	2.80E-12	B B 2
Zn 65	7.82E-10	B B 2	9.25E-09	B B 2	Ra 223	4.24E-10	B B 2	2.29E-10	B B 2
Se 79	1.36E-06	B B 2	1.46E-06	B B 2	Ra 225	3.67E-09	B B 2	4.06E-12	B B 2
Kr 81	3.02E-12	B B 2	3.32E-12	B B 2	Ra 226	3.07E-07	B B 2	1.86E-11	B B 2
Kr 85	6.66E-02	B B 2	1.25E-01	B B 2	Ra 228	2.32E-10	B B 2	3.01E-15	B B 2
Rb 87	5.07E-10	B B 2	5.44E-10	B B 2	Ac 227	4.27E-10	B B 2	2.28E-10	B B 2
Sr 90	2.36E+00	B B 1	2.86E+00	B B 1	Th 227	4.19E-10	B B 2	2.26E-10	B B 2
Zr 93	4.32E-05	B B 2	4.63E-05	B B 2	Th 228	9.98E-04	B B 2	4.30E-07	B B 2
Nb 91	4.94E-18	B B 2	6.00E-18	B B 2	Th 229	3.69E-09	B B 2	4.06E-12	B B 2
Nb 92	1.37E-16	B B 2	1.46E-16	B B 2	Th 230	4.26E-05	B B 1	1.84E-05	B B 1
Nb 93m	2.61E-05	B B 2	1.93E-05	B B 2	Th 232	2.52E-10	B B 1	5.89E-15	B B 2
Nb 94	8.13E-03	B B 1	7.23E-07	B B 2	Th 234	2.56E-05	B B 2	1.05E-05	B B 2
Mo 93	3.73E-08	B B 2	3.04E-08	B B 2	Pa 231	1.13E-09	B B 2	8.18E-10	B B 2
Tc 97	3.98E-15	B B 2	4.25E-15	B B 2	Pa 233	1.01E-01	B B 2	5.38E-06	B B 2
Tc 99	2.00E-01	B B 1	2.09E-01	B B 1	U 232	1.25E-03	B B 2	4.52E-07	B B 2
Ru 106	4.33E-01	B B 1	3.58E+00	B B 1	U 233	4.62E-06	B B 2	6.35E-10	B B 2
Pd 107	2.17E-06	B B 2	2.33E-06	B B 2	U 234	9.38E-04	B B 1	1.27E-03	B B 1
Ag 108m	3.08E-10	B B 2	3.35E-10	B B 2	U 235	1.60E-06	B B 1	1.45E-06	B B 1
Ag 110m	4.31E-07	B B 2	4.99E-06	B B 2	U 236	1.45E-05	B B 1	1.32E-05	B B 1
Cd 109	1.02E-11	B B 2	6.98E-11	B B 2	U 238	2.57E-05	B B 1	2.24E-05	B B 1
Cd 113m	2.32E-04	B B 2	3.96E-04	B B 2	Np 237	1.02E-01	B B 1	1.07E-01	B B 1
Sn 119m	1.68E-08	B B 2	1.69E-07	B B 2	Pu 236	1.39E-02	B B 1	5.23E-02	B B 1
Sn 121m	4.44E-04	B B 2	5.45E-04	B B 2	Pu 238	1.70E-01	B B 1	1.95E-01	B B 1
Sn 123	7.08E-11	B B 2	1.53E-09	B B 2	Pu 239	3.14E-02	B B 1	3.11E-02	B B 1
Sn 126	7.23E-06	B B 2	7.78E-06	B B 2	Pu 240	5.11E-02	B B 1	5.19E-02	B B 1
Sb 125	8.90E-01	B B 2	3.47E+00	B B 2	Pu 241	3.07E+00	B B 1	4.83E+00	B B 1
Sb 126	1.02E-06	B B 2	2.51E-06	B B 2	Pu 242	1.95E-04	B B 1	2.17E-04	B B 1
Te 125m	2.05E-01	B B 2	5.41E-03	B B 2	Am 241	3.32E-01	B B 1	3.41E-01	B B 1
Te 127m	1.92E-11	B B 2	4.92E-10	B B 2	Am 242m	1.03E-04	B B 2	1.21E-04	B B 2
I 129	7.13E-07	B B 2	7.64E-07	B B 2	Am 243	2.17E-04	B B 2	2.50E-04	B B 2
Cs 134	5.56E-02	B B 1	2.63E-01	B B 1	Cm 242	8.49E-05	B B 1	1.01E-04	B B 2
Cs 135	1.16E-05	B B 2	1.29E-05	B B 2	Cm 243	1.27E-04	B B 1	1.60E-04	B B 1
Cs 137	5.43E+00	B B 1	7.06E+00	B B 1	Cm 244	8.42E-03	B B 1	1.24E-02	B B 1
Ba 133	4.61E-11	B B 2	8.70E-11	B B 2	Cm 245	1.85E-06	B B 2	2.25E-06	B B 2
La 137	6.71E-11	B B 2	7.17E-11	B B 2	Cm 246	2.97E-07	B B 2	3.75E-07	B B 2
La 138	5.63E-15	B B 2	5.97E-15	B B 2	Cm 248	1.75E-12	B B 2	2.33E-12	B B 2
Ce 144	2.83E-03	B B 2	2.92E-02	B B 2	Cf 249	1.62E-11	B B 2	2.22E-11	B B 2
Pm 145	8.61E-12	B B 2	1.38E-11	B B 2	Cf 250	3.94E-11	B B 2	7.53E-11	B B 2
Pm 147	8.97E-02	B B 2	3.61E-01	B B 2	Cf 251	6.02E-13	B B 2	8.32E-13	B B 2
Sm 147	1.73E-10	B B 2	1.78E-10	B B 2	Cf 252	1.23E-12	B B 2	4.95E-12	B B 2
Sm 151	5.99E-03	B B 2	6.77E-03	B B 2	Unsp a	2.97E-05	B B 2	3.72E-05	B B 2
Eu 152	4.77E-05	B B 2	8.29E-05	B B 2	Unsp b/g	8.29E-03	B B 2	7.92E-03	B B 2
Eu 154	6.30E-02	B B 1	1.28E-01	B B 1	Total a	7.13E-01	*	7.93E-01	*
Eu 155	4.72E-03	B B 2	1.31E-02	B B 2	Total b/g	1.37E+01	*	2.48E+01	*

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