

WASTE STREAM	2F03/C	Encapsulated AGR 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		2000.0	2248.0
Future arisings:				0.0
Total future arisings:			0.0	0.0
Total waste volume:			2000.0	2248.0

Number of waste packages in stock: At 1.4.2025..... 3937 packages

Comment on arising rates: -

Additional information on quantities: Known volume in store, no more future arisings other than what's currently in WEP cave awaiting export.

Uncertainty factors on volumes:

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

WASTE SOURCE Leached stainless steel hulls from the reprocessing of AGR fuel.

PHYSICAL CHARACTERISTICS

General description: The waste is AGR cladding, chopped and leached fuel pins and debris from the slotted can which holds the pins during shearing. This is then encapsulated in a grout matrix. No items require special handling.

Changes since waste generated: This waste does not go through any physical or chemical process prior to conditioning.

Bulk density (t/m³): ~ 2.3

Comment on density: Density of conditioned waste. Raw waste density ~0.5 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless steel (22%), sintox (0.9%), UO₂ (<0.1%), grout (77%).

Chemical state: -

Sheet metal proportion / thickness: Mostly rings approx 1cm diameter by 5 cm long. Some can material ~2mm thick.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 21.9	Type 20/25 Nb.	100.0
Other ferrous metals.....	= 0	-	
Iron.....	-	-	
Aluminium.....	-	-	
Beryllium.....	TR	-	
Cobalt.....	= 0	-	
Copper.....	-	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	-	-	
Titanium.....	NE	-	
Uranium.....	< 0.10	Insoluble fission product residue and fines.	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
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...	TR	-	
Condensation polymers...	TR	-	
Others...	TR	-	
Organic ion exchange materials...	= 0	-	
Total rubber...	TR	-	
Halogenated rubber...	= 0	-	
Non-halogenated rubber...	TR	-	
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...	~ 77.0	No sand is present in encapsulation grout.	
Sand...	= 0	-	
Glass/Ceramics...	= 1.0	-	
Graphite...	= 0	-	
Desiccants/Catalysts...	= 0	-	
Asbestos...	= 0	No asbestos present in this waste.	
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...	TR	-
Nitrite...	TR	-
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...	= 0	-
Biological etc. materials...	= 0	-
Biodegradable materials...	= 0	-
Putrescible wastes...	= 0	-
Non-putrescible wastes...	= 0	-
Corrosive materials...	P	Alkaline encapsulation grout.
Pyrophoric materials...	= 0	-
Generating toxic gases...	= 0	-
Reacting with water...	= 0	-
Higher activity particles...	NE	Small fraction bound by encapsulation grout.
Soluble solids as bulk chemical compounds...	P	Some sodium and 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 is encapsulation grout OPC.
Molybdenum.....	= 0	-
Thallium.....		-
Tin.....	P	Trace amount in encapsulation grout OPC.
Vanadium.....	= 0	-
Mercury compounds.....		-
Others.....	= 0	-

Complexing agents (%wt):

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

Encapsulation in Wastes Encapsulation Plant.

Conditioning plants:

Plant Name	Location
Wastes Encapsulation Plant (WEP)	Sellafield

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

BFS/OPC 3:1 to 5.67:1 (4.5:1) @ 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	0.51	0.51	3937	-

Range in container waste loading:

Other information on packaging and conditioning: The waste is already conditioned.

Conditioned density (t/m³): = 2.3

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: Fission product carry-over and activation products will be present in the chopped and leached fuel pin debris. Cobalt-60 will be dominant.

Uncertainty: -

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

Chemical form of radionuclides:

H-3: Within stainless steel.
C-14: Not estimated.
Cl-36: Present as trace amounts of clathrate compounds of metallic salts readily lost to aqueous solution.
Se-79: Not estimated.
Tc-99: Not estimated.
I-129: Present as trace amounts of clathrate compounds of metallic salts readily lost to aqueous solution.
Ra: Not estimated.
Th: Not estimated.
U: Fuel fines UO₂.
Np: Not estimated.
Pu: Fuel fines PuO₂.

WASTE STREAM			2F03/C		Encapsulated AGR Cladding				
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	8.58E-03	B B 2			Gd 153	2.06E-11	B B 2		
Be 10	1.65E-08	B B 2			Ho 163	3.62E-12	B B 2		
C 14	1.60E-02	B B 2			Ho 166m	1.49E-07	B B 2		
Na 22					Tm 170	3.07E-20	B B 2		
Al 26					Tm 171	3.83E-08	B B 2		
Cl 36	1.81E-05	B B 2			Lu 174				
Ar 39	3.16E-04	B B 2			Lu 176				
Ar 42					Hf 178n				
K 40	1.37E-09	B B 2			Hf 182	1.24E-16	B B 2		
Ca 41	2.36E-05	B B 2			Pt 193				
Mn 53	1.65E-15	B B 2			Tl 204				
Mn 54	1.23E-04	B B 1			Pb 205				
Fe 55	1.27E+01	B B 2			Pb 210	6.52E-11	B B 2		
Co 60	1.39E+00	B B 1			Bi 208				
Ni 59	1.10E+00	B B 2			Bi 210m				
Ni 63	1.08E+02	B B 2			Po 210	6.21E-11	B B 2		
Zn 65	1.74E-05	B B 1			Ra 223	1.46E-09	B B 2		
Se 79	4.37E-06	B B 2			Ra 225	1.11E-11	B B 2		
Kr 81	7.99E-12	B B 2			Ra 226	2.55E-10	B B 2		
Kr 85	1.68E-01	B B 2			Ra 228	3.31E-14	B B 2		
Rb 87	1.63E-09	B B 2			Ac 227	1.47E-09	B B 2		
Sr 90	3.28E+00	B B 2			Th 227	1.44E-09	B B 2		
Zr 93	1.39E-04	B B 2			Th 228	7.44E-07	B B 2		
Nb 91	9.43E-18	B B 2			Th 229	1.11E-11	B B 2		
Nb 92	4.08E-16	B B 2			Th 230	3.94E-08	B B 2		
Nb 93m	9.07E-05	B B 2			Th 232	4.64E-14	B B 2		
Nb 94	6.37E-02	B B 2			Th 234	4.54E-05	B B 2		
Mo 93					Pa 231	3.28E-09	B B 2		
Tc 97	1.19E-14	B B 2			Pa 233	1.54E-05	B B 2		
Tc 99	1.07E-03	B B 2			U 232	7.28E-07	B B 1		
Ru 106	8.30E-03	B B 1		U 233	2.43E-09	B B 1			
Pd 107	6.38E-06	B B 2		U 234	1.49E-04	B B 1			
Ag 108m	4.37E-01	B B 1		U 235	2.39E-06	B B 1			
Ag 110m	8.25E-07	B B 1		U 236	3.39E-05	B B 1			
Cd 109	1.33E-12	B B 2		U 238	4.54E-05	B B 1			
Cd 113m	5.71E-04	B B 2		Np 237	1.55E-05	B B 2			
Sn 119m	3.72E-10	B B 2		Pu 236	9.43E-08	B B 2			
Sn 121m	1.32E-03	B B 2		Pu 238	8.49E-02	B B 1			
Sn 123	2.26E-15	B B 2		Pu 239	2.13E-02	B B 1			
Sn 126	2.20E-05	B B 2		Pu 240	4.54E-02	B B 1			
Sb 125	3.04E-01	B B 1		Pu 241	1.81E+00	B B 1			
Sb 126	3.07E-06	B B 2		Pu 242	7.82E-05	B B 1			
Te 125m	7.62E-02	B B 2		Am 241	1.43E-01	B B 2			
Te 127m	7.18E-17	8		Am 242m	2.81E-04	B B 2			
I 129	2.23E-06	B B 2		Am 243	4.48E-04	B B 2			
Cs 134	3.20E-03	B B 1		Cm 242	2.32E-04	B B 2			
Cs 135	3.94E-05	B B 2		Cm 243	2.77E-04	B B 2			
Cs 137	3.18E+00	B B 1		Cm 244	9.34E-03	B B 1			
Ba 133	1.09E-10	B B 2		Cm 245	1.71E-06	B B 2			
La 137	2.01E-10	B B 2		Cm 246	2.57E-07	B B 2			
La 138	1.09E-14	B B 2		Cm 248	5.87E-13	B B 2			
Ce 144	2.07E-05	B B 1		Cf 249	2.83E-12	B B 2			
Pm 145	1.71E-11	B B 2		Cf 250	6.18E-12	B B 2			
Pm 147	7.24E-02	B B 2		Cf 251	7.31E-14	B B 2			
Sm 147	6.11E-10	B B 2		Cf 252	1.01E-13	B B 2			
Sm 151	1.91E-02	B B 2		Unsp a	7.30E-05	B B 2			
Eu 152	5.90E-03	B B 1		Unsp b/g	2.29E-02	B B 2			
Eu 154	2.70E-02	B B 1		Total a	3.05E-01	*	0	*	
Eu 155	6.33E-03	B B 2		Total b/g	1.33E+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