

WASTE STREAM	2F01/C	Vitrified High Level Waste
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SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Ltd

WASTE TYPE HLW

WASTE VOLUMES

Stocks:
Future arisings:

	Reported (m ³)
At 1.4.2025	
1.4.2025 - 31.3.2026	
1.4.2026 - 31.3.2027	
1.4.2027 - 31.3.2028	
1.4.2028 - 31.3.2029	
1.4.2029 - 31.3.2030	
1.4.2030 - 31.3.2031	
1.4.2031 - 31.3.2032	
1.4.2032 - 31.3.2033	
1.4.2033 - 31.3.2034	
1.4.2034 - 31.3.2035	
1.4.2035 - 31.3.2036	

OR

Conditioned (m ³)	Packaged (m ³)
= 917.1	1198.3
= -3.3	0.0
= 20.3	26.5
= 16.1	21.0
= -4.9	0.0
= -1.3	0.0
= -3.4	0.0
= 10.0	13.1
= 10.0	13.1
= 10.0	13.1
= 10.0	13.1
= 7.4	9.6
70.8	92.5
987.9	1290.9

Total future arisings:
Total waste volume:

Number of waste packages in stock: At 1.4.2025..... 6114 packages

Comment on arising rates: Arisings are dependent on the vitrification programme. The volumes quoted are net of exports to overseas customers. Future arisings are based on an assumed end date for the HAL Programme of 2039, with vitrification operations ending in 2037. Overseas returns will end in 2030.

Additional information on quantities: The reported volumes and numbers of packages are the total number of waste packages. Future arisings will be dependent on the adopted upstream liquor blending strategy and a degree of uncertainty is introduced as a result. However the overall uncertainty for waste package production for 2F01/C is small, +/-x1.2.

Uncertainty factors on volumes: Stock (upper): x 1.10 Arisings (upper): x 1.20
Stock (lower): x 0.90 Arisings (lower): x 0.83

WASTE SOURCE Reprocessing of spent fuel gives rise to acidic aqueous raffinate which is concentrated, then vitrified by thermally denitrating and mixing with glass formers.

PHYSICAL CHARACTERISTICS

General description: Vitrified waste is the oxide form of the fission products from spent fuel incorporated in a borosilicate lithia glass matrix. The glass blocks are cast in stainless steel product containers. Each container holds approximately 400 kg of glass. No large items are present, individual containers are approximately 430 mm diameter and 1340 mm high.

Changes since waste generated: No change since generation.

Bulk density (t/m³): = 2.7

Comment on density: Density is based on an average 400kg of glass per container, with 0.15m³ glass. Actual density of each individual container will vary slightly.

CHEMICAL COMPOSITION

General description and components (%wt): SiO₂ (47.2%), Na₂O (8.6%), B₂O₃ (17.3%), Li₂O (2.0%), waste oxides (25%).

Chemical state: Neutral

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	-	-	-
Other ferrous metals.....	-	-	-
Iron.....	-	-	-
Aluminium.....	-	-	-
Beryllium.....	-	-	-
Cobalt.....	-	-	-
Copper.....	-	-	-
Lead.....	-	-	-
Magnox/Magnesium.....	-	-	-
Nickel.....	-	-	-
Titanium.....	-	-	-
Uranium.....	-	-	-
Zinc.....	-	-	-
Zircaloy/Zirconium.....	-	-	-
Other metals.....	-	-	-

Organics (%wt):

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

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.....	= 0	-	-
Sand.....	= 0	-	-
Glass/Ceramics.....	= 100.0	-	-
Graphite.....	= 0	-	-
Desiccants/Catalysts.....	= 0	-	-
Asbestos.....	= 0	-	-
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.....	-	-
Chloride.....	-	-
Iodide.....	-	-
Cyanide.....	-	-
Carbonate.....	-	-
Nitrate.....	-	-
Nitrite.....	-	-
Phosphate.....	-	-
Sulphate.....	-	-
Sulphide.....	-	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	-	-
Low flash point liquids.....	-	-
Explosive materials.....	-	-
Phosphorus.....	-	-
Hydrides.....	-	-
Biological etc. materials.....	-	-
Biodegradable materials.....	-	-
Putrescible wastes.....	-	-
Non-putrescible wastes.....	-	-
Corrosive materials.....	-	-
Pyrophoric materials.....	-	-
Generating toxic gases.....	-	-
Reacting with water.....	-	-
Higher activity particles.....	-	-
Soluble solids as bulk chemical compounds.....	-	-

Hazardous substances / non hazardous pollutants:

-		
	(%wt)	Type(s) and comment
Acrylamide.....	-	-
Benzene.....	-	-
Chlorinated solvents.....	-	-
Formaldehyde.....	-	-
Organometallics.....	-	-
Phenol.....	-	-
Styrene.....	-	-
Tri-butyl phosphate.....	-	-
Other organophosphates.....	-	-
Vinyl chloride.....	-	-
Arsenic.....	-	-
Barium.....	-	-
Boron.....	~ 5.0	-
Boron (in Boral).....	-	-
Boron (non-Boral).....	~ 5.0	Based on Boron in glass and assumed 28 wt% incorporation
Cadmium.....	-	-
Caesium.....	-	-
Selenium.....	-	-
Chromium.....	-	-
Molybdenum.....	-	-
Thallium.....	-	-
Tin.....	-	-
Vanadium.....	-	-
Mercury compounds.....	-	-
Others.....	-	-

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.....	= 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 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	On-site	= 100.0

Comments on planned treatments:

All HLW is vitrified.

Conditioning method:

Vitrification.

Conditioning plants:

Plant Name	Location
Waste Vitrification Plant (WVP)	Sellafield

Likely conditioning matrix:

Glass

Further information on the conditioning matrix:

Borosilicate glass matrix

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
Steel Disposal Container HLW	100.0	0.15	0.15	6586	-

Range in container waste loading:

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

= 2.7

Conditioned density comment:

Based on average 400kg glass per container.

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) 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	= 100.0		

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 main sources of activity in the waste are mixed fission products and actinides resulting from the reprocessing of irradiated Oxide and Magnox fuels.

Uncertainty: -

Measurement of radioactivities: The specific activity has been derived from plant records and predictions of feed stocks to the conditioning plant and a target waste incorporation of 25-28% in the conditioning matrix.

Chemical form of radionuclides: H-3: Not present.
C-14: Not present.
Cl-36: Present as oxide in trace quantities.
Se-79: Present as oxide.
Tc-99: Present as oxide.
I-129: Present as oxide.
Ra: Likely to be present as oxides.
Th: Likely to be present as oxides.
U: Present as oxide.
Np: Likely to be present as oxide.
Pu: Present as oxide.

WASTE STREAM		2F01/C		Vitrified High Level Waste					
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		8	Gd 153	= 6.91E-08	A A 2	= 6.91E-08	B B 2
Be 10	= 6.38E-05	A A 2	= 6.38E-05	B B 2	Ho 163	= 1.67E-08	A A 2	= 1.67E-08	B B 2
C 14		8		8	Ho 166m	= 6.48E-04	A A 2	= 6.48E-04	B B 2
Na 22		6		6	Tm 170	= 2.30E-12	A A 2	= 2.30E-12	B B 2
Al 26		6		6	Tm 171	= 1.88E-05	A A 2	= 1.88E-05	B B 2
Cl 36		8		8	Lu 174	= 2.90E-10	A A 2	= 2.90E-10	B B 2
Ar 39		8		8	Lu 176	= 3.58E-14	A A 2	= 3.58E-14	B B 2
Ar 42		8		8	Hf 178n		8		8
K 40	= 7.82E-09	A A 2	= 7.82E-09	B B 2	Hf 182	= 5.33E-13	A A 2	= 5.33E-13	B B 2
Ca 41	= 1.94E-04	A A 2	= 1.94E-04	B B 2	Pt 193	= 1.01E-08	A A 2	= 1.01E-08	B B 2
Mn 53	= 1.90E-10	A A 2	= 1.90E-10	B B 2	Tl 204	= 4.60E-10	A A 2	= 4.60E-10	B B 2
Mn 54	= 5.68E-06	A A 2	= 5.68E-06	B B 2	Pb 205	= 2.98E-10	A A 2	= 2.98E-10	B B 2
Fe 55	= 7.86E-02	A A 2	= 7.86E-02	B B 2	Pb 210	= 5.30E-07	A A 2	= 5.30E-07	B B 2
Co 60	= 1.41E+00	A A 2	= 1.41E+00	B B 2	Bi 208	= 6.15E-14	A A 2	= 6.15E-14	B B 2
Ni 59	= 2.67E-03	A A 2	= 2.67E-03	B B 2	Bi 210m	= 1.28E-14	A A 2	= 1.28E-14	B B 2
Ni 63	= 2.60E-01	A A 2	= 2.60E-01	B B 2	Po 210	= 5.18E-07	A A 2	= 5.18E-07	B B 2
Zn 65	= 2.20E-09	A A 2	= 2.20E-09	B B 2	Ra 223	= 5.90E-06	A A 2	= 5.90E-06	B B 2
Se 79	= 1.74E-02	A A 2	= 1.74E-02	B B 2	Ra 225	= 2.87E-08	A A 2	= 2.87E-08	B B 2
Kr 81		8		8	Ra 226	= 1.17E-06	A A 2	= 1.17E-06	B B 2
Kr 85	= 1.27E-20	A A 2	= 1.27E-20	B B 2	Ra 228	= 5.38E-11	A A 2	= 5.38E-11	B B 2
Rb 87	= 6.43E-06	A A 2	= 6.43E-06	B B 2	Ac 227	= 5.91E-06	A A 2	= 5.91E-06	B B 2
Sr 90	= 9.43E+03	A A 2	= 9.43E+03	B B 2	Th 227	= 5.82E-06	A A 2	= 5.82E-06	B B 2
Zr 93	= 5.52E-01	A A 2	= 5.52E-01	B B 2	Th 228	= 3.03E-05	A A 2	= 3.03E-05	B B 2
Nb 91	= 6.35E-08	A A 2	= 6.35E-08	B B 2	Th 229	= 2.87E-08	A A 2	= 2.87E-08	B B 2
Nb 92	= 4.98E-10	A A 2	= 4.98E-10	B B 2	Th 230	= 7.50E-05	A A 2	= 7.50E-05	B B 2
Nb 93m	= 4.39E-01	A A 2	= 4.39E-01	B B 2	Th 232	= 5.72E-11	A A 2	= 5.72E-11	B B 2
Nb 94	= 3.80E-05	A A 2	= 3.80E-05	B B 2	Th 234	= 2.13E-05	A A 2	= 2.13E-05	B B 2
Mo 93	= 2.11E-04	A A 2	= 2.11E-04	B B 2	Pa 231	= 8.81E-06	A A 2	= 8.81E-06	B B 2
Tc 97	= 3.41E-11	A A 2	= 3.41E-11	B B 2	Pa 233	= 3.72E-02	A A 2	= 3.72E-02	B B 2
Tc 99	= 2.68E+00	A A 2	= 2.68E+00	B B 2	U 232	= 7.20E-07	A A 2	= 7.20E-07	B B 2
Ru 106	= 2.93E-01	A A 2	= 2.93E-01	B B 2	U 233	= 3.25E-06	A A 2	= 3.25E-06	B B 2
Pd 107	= 2.85E-02	A A 2	= 2.85E-02	B B 2	U 234	= 1.03E-04	A A 2	= 1.03E-04	B B 2
Ag 108m	= 4.93E-06	A A 2	= 4.93E-06	B B 2	U 235	= 1.01E-06	A A 2	= 1.01E-06	B B 2
Ag 110m	= 1.30E-05	A A 2	= 1.30E-05	B B 2	U 236	= 1.17E-05	A A 2	= 1.17E-05	B B 2
Cd 109	= 4.53E-09	A A 2	= 4.53E-09	B B 2	U 238	= 2.13E-05	A A 2	= 2.13E-05	B B 2
Cd 113m	= 1.42E+00	A A 2	= 1.42E+00	B B 2	Np 237	= 3.72E-02	A A 2	= 3.72E-02	B B 2
Sn 119m	= 2.09E-06	A A 2	= 2.09E-06	B B 2	Pu 236	= 2.28E-07	A A 2	= 2.28E-07	B B 2
Sn 121m	= 4.68E+00	A A 2	= 4.68E+00	B B 2	Pu 238	= 7.73E-01	A A 2	= 7.73E-01	B B 2
Sn 123	= 3.58E-08	A A 2	= 3.58E-08	B B 2	Pu 239	= 1.70E-01	A A 2	= 1.70E-01	B B 2
Sn 126	= 4.10E-02	A A 2	= 4.10E-02	B B 2	Pu 240	= 4.11E-01	A A 2	= 4.11E-01	B B 2
Sb 125	= 3.26E+00	A A 2	= 3.26E+00	B B 2	Pu 241	= 9.99E+00	A A 2	= 9.99E+00	B B 2
Sb 126	= 3.04E-02	A A 2	= 3.04E-02	B B 2	Pu 242	= 6.62E-04	A A 2	= 6.62E-04	B B 2
Te 125m	= 7.96E-01	A A 2	= 7.96E-01	B B 2	Am 241	= 3.67E+02	A A 2	= 3.67E+02	B B 2
Te 127m	= 3.00E-08	A A 2	= 3.00E-08	B B 2	Am 242m	= 9.86E-01	A A 2	= 9.86E-01	B B 2
I 129	= 2.98E-19	A A 2	= 2.98E-19	B B 2	Am 243	= 1.57E+00	A A 2	= 1.57E+00	B B 2
Cs 134	= 3.18E+00	A A 2	= 3.18E+00	B B 2	Cm 242	= 8.15E-01	A A 2	= 8.15E-01	B B 2
Cs 135	= 1.95E-01	A A 2	= 1.95E-01	B B 2	Cm 243	= 6.35E-01	A A 2	= 6.35E-01	B B 2
Cs 137	= 1.32E+04	A A 2	= 1.32E+04	B B 2	Cm 244	= 4.68E+01	A A 2	= 4.68E+01	B B 2
Ba 133	= 5.50E-06	A A 2	= 5.50E-06	B B 2	Cm 245	= 1.43E-02	A A 2	= 1.43E-02	B B 2
La 137	= 9.26E-07	A A 2	= 9.26E-07	B B 2	Cm 246	= 2.69E-03	A A 2	= 2.69E-03	B B 2
La 138	= 5.19E-11	A A 2	= 5.19E-11	B B 2	Cm 248	= 2.13E-08	A A 2	= 2.13E-08	B B 2
Ce 144	= 8.67E-02	A A 2	= 8.67E-02	B B 2	Cf 249	= 2.07E-07	A A 2	= 2.07E-07	B B 2
Pm 145	= 2.36E-05	A A 2	= 2.36E-05	B B 2	Cf 250	= 3.23E-07	A A 2	= 3.23E-07	B B 2
Pm 147	= 5.17E+01	A A 2	= 5.17E+01	B B 2	Cf 251	= 8.99E-09	A A 2	= 8.99E-09	B B 2
Sm 147	= 2.53E-06	A A 2	= 2.53E-06	B B 2	Cf 252	= 9.83E-10	A A 2	= 9.83E-10	B B 2
Sm 151	= 9.33E+01	A A 2	= 9.33E+01	B B 2	Unsp a	NE	6	NE	6
Eu 152	= 4.62E-01	A A 2	= 4.62E-01	B B 2	Unsp b/g	NE	6	NE	6
Eu 154	= 1.06E+02	A A 2	= 1.06E+02	B B 2	Total a	4.18E+02	*	4.18E+02	*
Eu 155	= 8.38E+00	A A 2	= 8.38E+00	B B 2	Total b/g	2.30E+04	*	2.30E+04	*

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