

WASTE STREAM	2D02	High Level Liquid Waste
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SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Ltd

WASTE TYPE HLW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025	= 1043.0		
Future arisings:	1.4.2025 - 31.3.2026	~ -58.0		
	1.4.2026 - 31.3.2027	~ -94.0		
	1.4.2027 - 31.3.2028	~ -40.0		
	1.4.2028 - 31.3.2029	~ -76.0		
	1.4.2029 - 31.3.2030	~ -40.0		
	1.4.2030 - 31.3.2031	~ 14.0		
	1.4.2031 - 31.3.2032	~ -130.0		
	1.4.2032 - 31.3.2033	~ -76.0		
	1.4.2033 - 31.3.2034	~ -76.0		
	1.4.2034 - 31.3.2035	~ -76.0		
	1.4.2035 - 31.3.2036	~ -76.0		
	1.4.2036 - 31.3.2037	~ -94.0		
	1.4.2037 - 31.3.2038	~ -71.0		
Total future arisings:		-893.0		
Total waste volume:		150.0		

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

Comment on arising rates: Arisings are based on the HA Liquor from POCO washings and planned transfers to the Waste Vitrification Plants resulting in a net decrease in stocks over time. The remaining waste volume is from liquor heels in the HASTs which will not be removed until after POCO operations. The route for this removal has not been confirmed. Heels have been reported according to current approved plans. Remaining volumes may also be reduced through in-tank evaporation.

Additional information on quantities: Uncertainties in arising and processing rates along with stored liquor dilution variability support an estimated uncertainty range of +/- 1.5 at this time.

Uncertainty factors on volumes: Stock (upper): x 1.10 Arisings (upper): x 1.50
Stock (lower): x 0.90 Arisings (lower): x 0.67

WASTE SOURCE Concentrated fission product solution from the first stage of primary separation in reprocessing plants.
Concentrated washings from HALES POCO.

PHYSICAL CHARACTERISTICS

General description: The waste is a nitric acid solution containing fission products, some actinides and some solids. There are no large items which require special handling.

Changes since waste generated: None.

Bulk density (t/m³): = 1.2

Comment on density: The average material density of the waste is 1.21 t/m3.

CHEMICAL COMPOSITION

General description and components (%wt): Nitric acid, fission product nitrates and oxides, corrosion products (iron, magnesium, chromium, nickel, aluminium), actinides and phosphates.

Chemical state: Acid

Sheet metal proportion / thickness: No metallic items are present.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0	-	
Other ferrous metals.....	= 0	-	
Iron.....	= 0	-	
Aluminium.....	= 0	-	
Beryllium.....	= 0	-	
Cobalt.....	= 0	-	
Copper.....	= 0	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	TR	Nickel will be present as corrosion product	
Titanium.....	= 0	-	
Uranium.....	= 0	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	TR	Niobium will be present as corrosion product	

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.....	-	-	
Inorganic sludges and flocs.....	-	-	
Soil.....	-	-	
Brick/Stone/Rubble.....	-	-	
Cementitious material.....	-	-	
Sand.....	-	-	
Glass/Ceramics.....	-	-	
Graphite.....	-	-	
Desiccants/Catalysts.....	-	-	
Asbestos.....	-	-	
Non/low friable.....	-	-	
Moderately friable.....	-	-	
Highly friable.....	-	-	
Free aqueous liquids.....	= 100.0	-	
Free non-aqueous liquids.....	-	-	
Powder/Ash.....	-	-	

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	= 0	-
Chloride.....	< 0.10	-
Iodide.....	= 0	-
Cyanide.....	= 0	-
Carbonate.....	= 0	-
Nitrate.....	< 50.0	-
Nitrite.....	NE	-
Phosphate.....	< 0.25	-
Sulphate.....	TR	-
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.....	~ 15.0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	~ 15.0	-
Reacting with water.....	= 0	-
Higher activity particles.....	= 0	-
Soluble solids as bulk chemical compounds.....	= 0	-

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.....	-	-
Boron (in Boral).....	-	-
Boron (non-Boral).....	-	-
Cadmium.....	-	-
Caesium.....	-	-
Selenium.....	-	-
Chromium.....	-	-
Molybdenum.....	-	-
Thallium.....	-	-
Tin.....	-	-
Vanadium.....	-	-
Mercury compounds.....	-	-
Others.....	< 10.0	-

Complexing agents (%wt):

	(%wt)	Type(s) and comment
EDTA.....	= 0	-
DPTA.....	= 0	-
NTA.....	= 0	-
Polycarboxylic acids.....	-	-
Other organic complexants.....	-	Organic complexing agents may be present at low concentrations.
Total complexing agents.....	TR	-

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 liquid High Level Waste will be vitrified.

Conditioning method:

The liquid will be vitrified.

Conditioning plants:

Plant Name	Location
Waste Vitrification Plant (WVP)	Sellafield

Likely conditioning matrix:

Glass

Further information on the conditioning matrix:

Glass block within a stainless steel container.

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	1.1	0.15	137	-

Range in container waste loading:

Average incorporation of vitrified containers to date is ~1.1m³. This figure may change when POCO washout liquors are being vitrified.

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

= 2.7

Conditioned density comment:

Based on average 400kg per container in 0.15m³ glass.

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: The current activity accuracy is good, based on tank and analytical records with activities derived using FISPIN based decay calculations. Future arisings are assumed to be the same, but this has high uncertainty due to lack of knowledge on POCO washout liquors at present.

Measurement of radioactivities: Specific activity data has been derived using calculated activities from tank and analytical records along with nuclear codes. The resultant activities have been divided by the measured waste volume to produce the specific activities reported.

Chemical form of radionuclides: H-3: Likely to be present as water
C-14: Unknown - possibly present as traces of dissolved solvent.
Cl-36: Unknown
Se-79: Present as nitrate
Tc-99: Present as nitrate
I-129: Unknown
Ra: Likely to be present as nitrate
Th: Present as nitrate
U: Present as nitrate
Np: Present as nitrate
Pu: Present as nitrate

WASTE STREAM		2D02		High Level Liquid 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	= 1.45E-09	A A 2	= 1.45E-09	D D 2
Be 10	= 1.48E-04	A A 2	= 1.48E-04	D D 2	Ho 163	= 4.46E-10	A A 2	= 4.46E-10	D D 2
C 14		8		8	Ho 166m	= 1.98E-05	A A 2	= 1.98E-05	D D 2
Na 22	= 3.51E-10	A A 2	= 3.51E-10	D D 2	Tm 170	= 4.63E-19	A A 2	= 4.63E-19	D D 2
Al 26		8		8	Tm 171	= 1.92E-06	A A 2	= 1.92E-06	D D 2
Cl 36	= 3.13E-04	A A 2	= 3.13E-04	D D 2	Lu 174		8		8
Ar 39		8		8	Lu 176	= 5.10E-37	A A 2	= 5.10E-37	D D 2
Ar 42		8		8	Hf 178n		8		8
K 40	= 6.84E-11	A A 2	= 6.84E-11	D D 2	Hf 182	= 1.63E-14	A A 2	= 1.63E-14	D D 2
Ca 41	= 1.17E-04	A A 2	= 1.17E-04	D D 2	Pt 193		8		8
Mn 53	= 2.21E-12	A A 2	= 2.21E-12	D D 2	Ti 204	= 4.68E-12	A A 2	= 4.68E-12	D D 2
Mn 54	= 7.21E-08	A A 2	= 7.21E-08	D D 2	Pb 205	= 2.92E-11	A A 2	= 2.92E-11	D D 2
Fe 55	= 2.94E-02	A A 2	= 2.94E-02	D D 2	Pb 210	= 8.78E-01	A A 2	= 8.78E-01	D D 2
Co 60	= 1.80E-01	A A 2	= 1.80E-01	D D 2	Bi 208		8		8
Ni 59	= 6.42E-04	A A 2	= 6.42E-04	D D 2	Bi 210m	= 7.31E-16	A A 2	= 7.31E-16	D D 2
Ni 63	= 7.11E-02	A A 2	= 7.11E-02	D D 2	Po 210	= 7.40E-01	A A 2	= 7.40E-01	D D 2
Zn 65	= 1.58E-11	A A 2	= 1.58E-11	D D 2	Ra 223	= 7.73E-07	A A 2	= 7.73E-07	D D 2
Se 79	= 1.22E-02	A A 2	= 1.22E-02	D D 2	Ra 225	= 4.33E-08	A A 2	= 4.33E-08	D D 2
Kr 81		8		8	Ra 226	= 1.42E-06	A A 2	= 1.42E-06	D D 2
Kr 85		8		8	Ra 228	= 3.84E-11	A A 2	= 3.84E-11	D D 2
Rb 87	= 9.61E-07	A A 2	= 9.61E-07	D D 2	Ac 227	= 7.74E-07	A A 2	= 7.74E-07	D D 2
Sr 90	= 1.75E+03	A A 2	= 1.75E+03	D D 2	Th 227	= 7.62E-07	A A 2	= 7.62E-07	D D 2
Zr 93	= 8.67E-02	A A 2	= 8.67E-02	D D 2	Th 228	= 7.71E-05	A A 2	= 7.71E-05	D D 2
Nb 91	= 1.79E-15	A A 2	= 1.79E-15	D D 2	Th 229	= 4.33E-08	A A 2	= 4.33E-08	D D 2
Nb 92	= 8.25E-12	A A 2	= 8.25E-12	D D 2	Th 230	= 3.04E-03	A A 2	= 3.04E-03	D D 2
Nb 93m	= 1.06E+01	A A 2	= 1.06E+01	D D 2	Th 232	= 2.52E-10	A A 2	= 2.52E-10	D D 2
Nb 94	= 2.23E-04	A A 2	= 2.23E-04	D D 2	Th 234	= 3.86E-04	A A 2	= 3.86E-04	D D 2
Mo 93	= 6.27E-05	A A 2	= 6.27E-05	D D 2	Pa 231	= 1.42E-06	A A 2	= 1.42E-06	D D 2
Tc 97	= 2.27E-12	A A 2	= 2.27E-12	D D 2	Pa 233	= 1.09E-02	A A 2	= 1.09E-02	D D 2
Tc 99	= 6.42E-01	A A 2	= 6.42E-01	D D 2	U 232	= 2.29E-07	A A 2	= 2.29E-07	D D 2
Ru 106	= 3.32E-01	A A 2	= 3.32E-01	D D 2	U 233	= 1.85E-06	A A 2	= 1.85E-06	D D 2
Pd 107	= 2.76E-03	A A 2	= 2.76E-03	D D 2	U 234	= 5.02E-05	A A 2	= 5.02E-05	D D 2
Ag 108m	= 6.33E-07	A A 2	= 6.33E-07	D D 2	U 235	= 1.23E-06	A A 2	= 1.23E-06	D D 2
Ag 110m	= 7.21E-08	A A 2	= 7.21E-08	D D 2	U 236	= 4.68E-06	A A 2	= 4.68E-06	D D 2
Cd 109	= 7.20E-09	A A 2	= 7.20E-09	D D 2	U 238	= 2.72E-05	A A 2	= 2.72E-05	D D 2
Cd 113m	= 1.66E-02	A A 2	= 1.66E-02	D D 2	Np 237	= 1.09E-02	A A 2	= 1.09E-02	D D 2
Sn 119m	= 1.99E-08	A A 2	= 1.99E-08	D D 2	Pu 236	= 5.57E-08	A A 2	= 5.57E-08	D D 2
Sn 121m	= 1.90E-01	A A 2	= 1.90E-01	D D 2	Pu 238	= 1.33E-01	A A 2	= 1.33E-01	D D 2
Sn 123	= 5.04E-14	A A 2	= 5.04E-14	D D 2	Pu 239	= 1.77E-02	A A 2	= 1.77E-02	D D 2
Sn 126	= 3.41E-02	A A 2	= 3.41E-02	D D 2	Pu 240	= 7.84E-02	A A 2	= 7.84E-02	D D 2
Sb 125	= 1.07E+00	A A 2	= 1.07E+00	D D 2	Pu 241	= 1.66E+00	A A 2	= 1.66E+00	D D 2
Sb 126	= 4.78E-03	A A 2	= 4.78E-03	D D 2	Pu 242	= 1.13E-04	A A 2	= 1.13E-04	D D 2
Te 125m	= 2.64E-01	A A 2	= 2.64E-01	D D 2	Am 241	= 7.41E+01	A A 2	= 7.41E+01	D D 2
Te 127m	= 1.06E-15	A A 2	= 1.06E-15	D D 2	Am 242m	= 2.07E-01	A A 2	= 2.07E-01	D D 2
I 129	= 8.88E-06	A A 2	= 8.88E-06	D D 2	Am 243	= 5.63E-01	A A 2	= 5.63E-01	D D 2
Cs 134	= 3.13E+00	A A 2	= 3.13E+00	D D 2	Cm 242	= 1.76E-01	A A 2	= 1.76E-01	D D 2
Cs 135	= 2.43E-02	A A 2	= 2.43E-02	D D 2	Cm 243	= 2.65E-01	A A 2	= 2.65E-01	D D 2
Cs 137	= 2.48E+03	A A 2	= 2.48E+03	D D 2	Cm 244	= 2.43E+01	A A 2	= 2.43E+01	D D 2
Ba 133	= 1.41E-08	A A 2	= 1.41E-08	D D 2	Cm 245	= 5.13E-03	A A 2	= 5.13E-03	D D 2
La 137	= 2.54E-08	A A 2	= 2.54E-08	D D 2	Cm 246	= 1.32E-03	A A 2	= 1.32E-03	D D 2
La 138	= 1.99E-12	A A 2	= 1.99E-12	D D 2	Cm 248	= 1.82E-08	A A 2	= 1.82E-08	D D 2
Ce 144	= 1.24E-01	A A 2	= 1.24E-01	D D 2	Cf 249	= 3.36E-07	A A 2	= 3.36E-07	D D 2
Pm 145	= 5.39E-12	A A 2	= 5.39E-12	D D 2	Cf 250	= 3.31E-07	A A 2	= 3.31E-07	D D 2
Pm 147	= 1.09E+01	A A 2	= 1.09E+01	D D 2	Cf 251	= 2.28E-08	A A 2	= 2.28E-08	D D 2
Sm 147	= 6.40E-07	A A 2	= 6.40E-07	D D 2	Cf 252	= 8.53E-10	A A 2	= 8.53E-10	D D 2
Sm 151	= 7.06E+00	A A 2	= 7.06E+00	D D 2	Unsp a	= 9.54E-04	A A 2	= 9.54E-04	D D 2
Eu 152	= 8.18E-02	A A 2	= 8.18E-02	D D 2	Unsp b/g	= 5.60E+03	A A 2	= 5.60E+03	D D 2
Eu 154	= 3.04E+01	A A 2	= 3.04E+01	D D 2	Total a	1.00E+02	*	1.00E+02	*
Eu 155	= 7.53E+00	A A 2	= 7.53E+00	D D 2	Total b/g	9.90E+03	*	9.90E+03	*

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