

<b>WASTE STREAM</b>	<b>2F22/C</b>	<b>High Level Contaminated Waste</b>
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**SITE** Sellafield  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Sellafield Limited  
**WASTE TYPE** HLW

**WASTE VOLUMES**

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>	0 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2023.....	0 m <sup>3</sup>	0 m <sup>3</sup>
	1.4.2023 - 31.3.2026.....	6.8 m <sup>3</sup>	8.8 m <sup>3</sup>
Total future arisings:		6.8 m <sup>3</sup>	8.8 m <sup>3</sup>
Total waste volume:		6.8 m <sup>3</sup>	8.8 m <sup>3</sup>
Number of waste packages in stock:	At 1.4.2019.....	0 package(s)	

**Comment on volumes:** Current assessments of the total waste arising in this stream indicate uncertainties of the order of +/-x3.

**Uncertainty factors on volumes:**  
 Stock (upper): x Arisings (upper) x 3.0  
 Stock (lower): x Arisings (lower) x 0.33

**WASTE SOURCE** HLW-contaminated plant items, usually cut up to improve packing efficiency.

**PHYSICAL CHARACTERISTICS**

**General description:** WVP highly active plant items consigned to this waste stream are primarily failed melter components contaminated with a quantity of vitrified waste. All items will be cut up remotely for storage in standard stainless steel vitrification containers.

**Physical components (%wt):** Melters (80%), calciner tubes (7%), dust scrubbers (7%), others (6%).

**Sealed sources:** The waste does not contain sealed sources.

**Bulk density (t/m<sup>3</sup>):** 3.5

**Comment on density:** The density is the mass of waste divided by the container payload volume.

**CHEMICAL COMPOSITION**

**General description and components (%wt):** Inconel (87%), Uranus 65 (5%), vitrified waste (5%), Stainless Steel (3%).

**Chemical state:** Neutral

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

**Metals and alloys (%wt):** Steel plate is typically 10 - 20mm thick.

Stainless steel.....	~8.0	~5% Uranus 65 (a modified grade 310L steel).
Other ferrous metals.....	0	
Iron.....	0	
Aluminium.....		
Beryllium.....	0	
Cobalt.....	0	
Copper.....		

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	Lead.....	0	
	Magnox/Magnesium.....	0	
	Nickel.....	87.0	Inconel.
	Titanium.....		
	Uranium.....	0	
	Zinc.....	0	
	Zircaloy/Zirconium.....	0	
	Other metals.....	0	
Organics (%wt):	No organic materials are present.		
	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.....	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):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	0	
	Sand.....		
	Glass/Ceramics.....	-5.0	
	Graphite.....	0	
	Desiccants/Catalysts.....		
	Asbestos.....	0	
	Non/low friable.....	0	
	Moderately friable.....	0	
	Highly friable.....	0	
	Free aqueous liquids.....	0	

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	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	No inorganic anions are present.	
	Fluoride.....	0
	Chloride.....	0
	Iodide.....	0
	Cyanide.....	0
	Carbonate.....	0
	Nitrate.....	0
	Nitrite.....	0
	Phosphate.....	0
	Sulphate.....	0
	Sulphide.....	0
Materials of interest for waste acceptance criteria:	No hazardous materials are present.	
	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.....	
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	0
	Active particles.....	
	Soluble solids as bulk chemical compounds.....	
Hazardous substances / non hazardous pollutants:	No toxic metals are present.	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	
	Styrene.....	
	Tri-butyl phosphate.....	
	Other organophosphates.....	
	Vinyl chloride.....	

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Arsenic.....  
 Barium.....  
 Boron.....  
 Cadmium.....  
 Caesium.....  
 Selenium.....  
 Chromium.....  
 Molybdenum.....  
 Thallium.....  
 Tin.....  
 Vanadium.....  
 Mercury compounds.....  
 Others.....  
 Electronic Electrical Equipment (EEE)  
     EEE Type 1..... 0  
     EEE Type 2..... 0  
     EEE Type 3..... 0  
     EEE Type 4..... 0  
     EEE Type 5..... 0  
 Complexing agents (%wt): No  
     EDTA..... 0  
     DPTA..... 0  
     NTA..... 0  
     Polycarboxylic acids.....  
     Other organic complexants.....  
     Total complexing agents.....

**PACKAGING AND CONDITIONING**

Container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	HLW canister	100.0	~0.15	~0.15	45

Container type comment: The waste stored volume is 150 litres per HLW container.

Range in container waste volume: -

Other information on containers: Stainless steel grade 309.

Conditioned density (t/m<sup>3</sup>): 3.5

Conditioned density comment: The density is based on the stored volume of 150 litres per HLW container.

Other information on conditioning: The waste is already conditioned.

**RADIOACTIVITY**

Source: Adherent vitrified fission product oxides and calcined fission product nitrates.

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Uncertainty:

The activities are estimated since there is no significant operational experience yet in producing HA waste containers. As such uncertainties are large.

Definition of total alpha and total beta/gamma:

The total alpha and beta/gamma activities are the sum of the reported nuclide activities only.

Measurement of radioactivities:

This waste is stored with a 50% stored volume voidage and contains about 5% vitrification plant product glass. On this basis the specific activity of this waste is estimated to be ~2.5% of the specific activity of the waste being processed in the vitrification plants.

Other information:

Short-lived daughters are not included. Other radionuclides not listed represent less than 0.01% of the total activity.

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3				8	Gd 153		7.90E-08	CC	2
Be 10			9.86E-07	CC 2	Ho 163		2.40E-10	CC	2
C 14				8	Ho 166m		2.21E-06	CC	2
Na 22					Tm 170		1.76E-13	CC	2
Al 26					Tm 171		5.16E-06	CC	2
Cl 36			3.96E-05	CC 2	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40			3.93E-19	CC 2	Hf 182		5.73E-15	CC	2
Ca 41			5.89E-06	CC 2	Pt 193				8
Mn 53			3.47E-12	CC 2	Tl 204				8
Mn 54			4.63E-06	CC 2	Pb 205		1.15E-11	CC	2
Fe 55			2.89E-02	CC 2	Pb 210		5.34E-09	CC	2
Co 60			2.18E-01	CC 2	Bi 208				8
Ni 59			7.94E-05	CC 2	Bi 210m		3.75E-16	CC	2
Ni 63			8.46E-03	CC 2	Po 210		5.14E-09	CC	2
Zn 65			3.22E-09	CC 2	Ra 223		1.11E-07	CC	2
Se 79			4.81E-04	CC 2	Ra 225		6.10E-10	CC	2
Kr 81				8	Ra 226		1.68E-08	CC	2
Kr 85				8	Ra 228		1.05E-12	CC	2
Rb 87			1.91E-07	CC 2	Ac 227		1.11E-07	CC	2
Sr 90			3.65E+02	CC 2	Th 227		1.09E-07	CC	2
Zr 93			1.62E-02	CC 2	Th 228		2.00E-06	CC	2
Nb 91			1.23E-16	CC 2	Th 229		6.10E-10	CC	2
Nb 92			2.78E-14	CC 2	Th 230		1.63E-06	CC	2
Nb 93m			1.09E-02	CC 2	Th 232		1.16E-12	CC	2
Nb 94			5.25E-06	CC 2	Th 234		7.17E-07	CC	2
Mo 93			6.03E-06	CC 2	Pa 231		2.07E-07	CC	2
Tc 97			2.42E-13	CC 2	Pa 233		9.25E-04	CC	2
Tc 99			7.74E-02	CC 2	U 232		1.83E-08	CC	2
Ru 106			1.90E-01	CC 2	U 233		6.00E-08	CC	2
Pd 107			8.51E-04	CC 2	U 234		2.51E-06	CC	2
Ag 108m			6.18E-08	CC 2	U 235		2.67E-08	CC	2
Ag 110m			1.60E-05	CC 2	U 236		1.95E-07	CC	2
Cd 109			8.28E-09	CC 2	U 238		7.17E-07	CC	2
Cd 113m			4.51E-02	CC 2	Np 237		9.26E-04	CC	2
Sn 119m			1.78E-06	CC 2	Pu 236		1.82E-08	CC	2
Sn 121m			1.24E-01	CC 2	Pu 238		3.01E-02	CC	2
Sn 123			1.84E-08	CC 2	Pu 239		7.02E-03	CC	2
Sn 126			2.66E-03	CC 2	Pu 240		1.64E-02	CC	2
Sb 125			7.42E-01	CC 2	Pu 241		5.04E-01	CC	2
Sb 126			8.55E-04	CC 2	Pu 242		2.84E-05	CC	2
Te 125m			1.81E-01	CC 2	Am 241		9.22E+00	CC	2
Te 127m			6.89E-09	CC 2	Am 242m		2.77E-02	CC	2
I 129			2.53E-06	CC 2	Am 243		5.26E-02	CC	2
Cs 134			9.50E-01	CC 2	Cm 242		2.28E-02	CC	2
Cs 135			5.25E-03	CC 2	Cm 243		3.32E-02	CC	2
Cs 137			5.04E+02	CC 2	Cm 244		3.02E+00	CC	2
Ba 133			8.16E-09	CC 2	Cm 245		7.42E-04	CC	2
La 137			1.36E-08	CC 2	Cm 246		1.70E-04	CC	2
La 138			3.96E-13	CC 2	Cm 248		1.49E-09	CC	2
Ce 144			7.40E-02	CC 2	Cf 249		1.19E-08	CC	2
Pm 145			7.80E-07	CC 2	Cf 250		2.80E-08	CC	2
Pm 147			1.47E+01	CC 2	Cf 251		5.61E-10	CC	2
Sm 147			7.28E-08	CC 2	Cf 252		4.19E-10	CC	2
Sm 151			3.08E+00	CC 2	Other a				
Eu 152			2.20E-02	CC 2	Other b/g				
Eu 154			5.60E+00	CC 2	<b>Total a</b>	<b>0</b>	<b>1.24E+01</b>	<b>CC</b>	<b>2</b>
Eu 155			8.99E-01	CC 2	<b>Total b/g</b>	<b>0</b>	<b>8.97E+02</b>	<b>CC</b>	<b>2</b>

**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 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