WASTE STREAM 2F22/C High Level Contaminated Waste

SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE HLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	0 m³	0 m³
Future arisings -	1.4.2022 - 31.3.2026.....	0 m³	0 m³
	1.4.2026 - 31.3.2030.....	~22.5 m³	29.4 m³
Total future arisings:		22.5 m³	29.4 m³
Total waste volume:		22.5 m³	29.4 m³
Number of waste packages in stock:	At 1.4.2022.....	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/m³): 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.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~8.0	~5% Uranus 65 (a modified grade 310L steel).	
Other ferrous metals.....	0		
Iron.....	0		

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Aluminium		
Beryllium	0	
Cobalt	0	
Copper		
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.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics			
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			

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Glass/Ceramics	~5.0
Graphite	0
Desiccants/Catalysts	
Asbestos	0
Non/low friable	0
Moderately friable	0
Highly friable	0
Free aqueous liquids	0
Free non-aqueous liquids	0
Powder/Ash	0

Inorganic anions (%wt): No inorganic anions are present.

	(%wt)	Type(s) and comment
Fluoride		
Chloride		
Iodide		
Cyanide		
Carbonate		
Nitrate		
Nitrite		
Phosphate		
Sulphate		
Sulphide		

Materials of interest for waste acceptance criteria: No hazardous materials are present.

	(%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		

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Hazardous substances / non hazardous pollutants: No toxic metals are present.

	(%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.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		
EEE Type 2.....		
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		

Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....		
Total complexing agents.....		

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Potential for the waste to contain discrete items: Yes. The waste will be packaged in discrete containers.

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
HLW canister	100.0	~0.15	~0.15	150

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^3): 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.

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. Data is based on current approved plans, however these are subject to review in the near future and expected to change.

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3				8	Gd 153			3.51E-11	C C 2
Be 10			3.23E-06	C C 2	Ho 163			8.57E-10	C C 2
C 14				8	Ho 166m			4.87E-05	C C 2
Na 22			NE		Tm 170			1.58E-19	C C 2
Al 26			NE		Tm 171			1.12E-06	C C 2
Cl 36				8	Lu 174			3.06E-11	C C 2
Ar 39				8	Lu 176			2.29E-15	C C 2
Ar 42				8	Hf 178n				8
K 40			5.31E-10	C C 2	Hf 182			3.25E-14	C C 2
Ca 41			1.31E-05	C C 2	Pt 193			8.07E-10	C C 2
Mn 53			5.22E-12	C C 2	Tl 204			6.32E-11	C C 2
Mn 54			3.20E-09	C C 2	Pb 205			2.82E-11	C C 2
Fe 55			2.57E-03	C C 2	Pb 210			1.65E-08	C C 2
Co 60			8.01E-02	C C 2	Bi 208			5.60E-15	C C 2
Ni 59			1.48E-04	C C 2	Bi 210m			1.17E-15	C C 2
Ni 63			1.50E-02	C C 2	Po 210			1.60E-08	C C 2
Zn 65			2.88E-11	C C 2	Ra 223			2.60E-07	C C 2
Se 79			8.89E-04	C C 2	Ra 225			1.80E-09	C C 2
Kr 81				8	Ra 226			4.64E-08	C C 2
Kr 85				8	Ra 228			3.24E-12	C C 2
Rb 87			3.28E-07	C C 2	Ac 227			2.61E-07	C C 2
Sr 90			5.54E+02	C C 2	Th 227			2.57E-07	C C 2
Zr 93			2.81E-02	C C 2	Th 228			4.55E-06	C C 2
Nb 91			5.49E-09	C C 2	Th 229			1.80E-09	C C 2
Nb 92			4.28E-11	C C 2	Th 230			3.98E-06	C C 2
Nb 93m			2.10E-02	C C 2	Th 232			3.52E-12	C C 2
Nb 94			2.37E-06	C C 2	Th 234			1.21E-05	C C 2
Mo 93			1.76E-05	C C 2	Pa 231			4.31E-07	C C 2
Tc 97			2.29E-12	C C 2	Pa 233			2.77E-03	C C 2
Tc 99			1.79E-01	C C 2	U 232			4.22E-07	C C 2
Ru 106			1.05E-03	C C 2	U 233			2.03E-07	C C 2
Pd 107			1.49E-03	C C 2	U 234			4.59E-05	C C 2
Ag 108m			2.92E-07	C C 2	U 235			6.56E-07	C C 2
Ag 110m			8.04E-09	C C 2	U 236			8.53E-06	C C 2
Cd 109			1.45E-09	C C 2	U 238			1.21E-05	C C 2
Cd 113m			1.00E-01	C C 2	Np 237			2.77E-03	C C 2
Sn 119m			1.65E-09	C C 2	Pu 236			2.35E-08	C C 2
Sn 121m			2.62E-01	C C 2	Pu 238			5.31E-02	C C 2
Sn 123			6.04E-16	C C 2	Pu 239			1.34E-02	C C 2
Sn 126			2.12E-03	C C 2	Pu 240			3.17E-02	C C 2
Sb 125			2.19E-01	C C 2	Pu 241			8.76E-01	C C 2
Sb 126			1.57E-03	C C 2	Pu 242			5.18E-05	C C 2
Te 125m			5.35E-02	C C 2	Am 241			2.41E+01	C C 2
Te 127m			6.62E-16	C C 2	Am 242m			5.21E-02	C C 2
I 129				8	Am 243			1.20E-01	C C 2
Cs 134			2.55E-01	C C 2	Cm 242			4.30E-02	C C 2
Cs 135			8.15E-03	C C 2	Cm 243			4.93E-02	C C 2
Cs 137			7.79E+02	C C 2	Cm 244			3.96E+00	C C 2
Ba 133			5.04E-07	C C 2	Cm 245			1.16E-03	C C 2
La 137			4.70E-08	C C 2	Cm 246			2.14E-04	C C 2
La 138			3.54E-12	C C 2	Cm 248			1.68E-09	C C 2
Ce 144			5.18E-05	C C 2	Cf 249			1.65E-08	C C 2
Pm 145			1.64E-06	C C 2	Cf 250			2.85E-08	C C 2
Pm 147			3.05E+00	C C 2	Cf 251			7.09E-10	C C 2
Sm 147			1.18E-07	C C 2	Cf 252			1.41E-10	C C 2
Sm 151			4.39E+00	C C 2	Other a				
Eu 152			2.20E-02	C C 2	Other b/g				
Eu 154			8.60E+00	C C 2	**Total a**	**0**		**2.83E+01**	**C C 2**
Eu 155			6.66E-01	C C 2	**Total b/g**	**0**		**1.35E+03**	**C C 2**

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