

WASTE STREAM	2F31	MSSS Compartment 11
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SITE Sellafield
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Sellafield Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	74.4 m ³
Total future arisings:		0 m ³
Total waste volume:		74.4 m ³
Comment on volumes:	There are no future arisings. Waste volume does not include cover liquor (520m ³).	
Uncertainty factors on volumes:	Stock (upper): x 2.0	Arisings (upper) x
	Stock (lower): x 0.5	Arisings (lower) x

WASTE SOURCE Leached oxide fuel hulls from reprocessing campaigns the head end plant from 1969 to 1974.

PHYSICAL CHARACTERISTICS

General description: The waste is Zircaloy fuel cladding from the reprocessing of Zircaloy clad oxide fuel. Also associated with the Zircaloy are fragments of undissolved uranium oxide fuel and stainless steel sheaths from the fuel assemblies. The waste is stored under water. Corrosion of Zircaloy is negligible. The waste includes some Beta/Gamma Waste which may include 2 m lengths of steel tubing.

Physical components (%wt): The main components are Zircaloy, Stainless Steel, Sand, Inconel, Uranium oxide and Aluminium oxide.

Sealed sources: Not yet determined.

Bulk density (t/m³): 0.58

Comment on density: Oxide Fuel Hulls and Sand

CHEMICAL COMPOSITION

General description and components (%wt): The main components are Zircaloy, Stainless Steel, Sand, Inconel, Uranium oxide and Aluminium oxide.

Chemical state: Alkali

Chemical form of radionuclides:
H-3: Present in reacted forms.
C-14: Present in reacted forms.
Cl-36: Present in reacted forms.
Se-79: Present in reacted forms.
Tc-99: Present in reacted forms.
I-129: Present in reacted forms.
Ra: Present in reacted forms.
Th: Present in reacted forms.
U: Present in reacted forms.
Np: Present in reacted forms.
Pu: Present in reacted forms.

Metals and alloys (%wt): The waste comprises mainly short lengths of fuel cladding tube, typically 50-150mm long and 10-16mm in diameter.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	P		
Other ferrous metals.....	NE		
Iron.....	NE		
Aluminium.....	NE		
Beryllium.....	NE		

WASTE STREAM	2F31	MSSS Compartment 11
---------------------	-------------	----------------------------

Cobalt.....	NE	
Copper.....	NE	
Lead.....	NE	
Magnox/Magnesium.....	NE	
Nickel.....	NE	Inconel.
Titanium.....	NE	
Uranium.....	P	
Zinc.....	NE	
Zircaloy/Zirconium.....	P	
Other metals.....	NE	

Organics (%wt): PVC.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....			
Wood.....			
Halogenated plastics	P		
Total non-halogenated plastics.....	P		
Condensation polymers.....	NE		
Others.....	P		
Organic ion exchange materials....	0		
Total rubber.....	NE		
Halogenated rubber			
Non-halogenated rubber.....			
Hydrocarbons.....	NE		
Oil or grease	NE		
Fuel.....	NE		
Asphalt/Tarmac (cont.coal tar)...	NE		
Asphalt/Tarmac (no coal tar)....	NE		
Bitumen.....	NE		
Others.....	NE		
Other organics.....	NE		

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.....	P		
Cementitious material.....	0		
Sand.....	P		
Glass/Ceramics.....	NE		
Graphite.....	NE		

WASTE STREAM	2F31	MSSS Compartment 11
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Desiccants/Catalysts.....	NE
Asbestos.....	NE
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): The water contains chloride.

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

Materials of interest for waste acceptance criteria: Zircaloy is present in the waste which may be a combustible hazard, particularly in the form of fines. The waste is stored under water.

	(%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.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....	P	
Soluble solids as bulk chemical compounds.....	NE	

WASTE STREAM	2F31	MSSS Compartment 11
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Hazardous substances /
non hazardous pollutants:

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

WASTE STREAM**2F31****MSSS Compartment 11**

Potential for the waste to contain discrete items: Not yet determined.

PACKAGING AND CONDITIONING

Conditioning method: This waste stream is outside of the current cLoC. It is currently envisaged that it will be possible to use the same processing facility and package type as is the case for the other MSSS waste streams.

Plant Name: TBD

Location: Sellafield

Plant startup date: 2070-2090

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): -

Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	Sellafield enhanced 3m ³ box	100.0	0.695	2.15	107

Likely container type comment: -

Range in container waste volume: There will be considerable variability in unconditioned waste volume per package due to variations in skip loading and content. The actual number of packages produced is identified in the Sellafield Retrievals Product and Secondary Waste Plan.

Other information on containers: Stainless Steel.

Likely conditioning matrix: BFS/OPC;PFA/OPC

Other information: -

Conditioned density (t/m³): ~2.0

Conditioned density comment: Density of conditioned waste will be fairly uniform.

Other information on conditioning: Waste matrix (as retrieved) will be in-filled with grout. A second pour of capping grout will be added. Void spaces between Skip wall and Box wall will be filled with grout.

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

RADIOACTIVITY

Source: The main sources are fission and activation products from fuel carry-over.

Uncertainty: The best available. Based on a short term oxide fuel reprocessing programme carried out between 1969 and 1974.

Definition of total alpha and total beta/gamma: Best available data.

WASTE STREAM

2F31

MSSS Compartment 11

Measurement of
radioactivities: -

Other information: -

WASTE STREAM

2F31

MSSS Compartment 11

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	1.49E-01	CC 2			Gd 153				
Be 10	3.80E-10	CC 2			Ho 163				
C 14	9.64E-03	CC 2			Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36	1.07E-05	CC 2			Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41	4.92E-06	CC 2			Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55	1.79E-04	CC 2			Pb 210	6.56E-10	CC 2		
Co 60	1.00E-01	CC 2			Bi 208				
Ni 59	1.22E-01	CC 2			Bi 210m				
Ni 63	1.06E+01	CC 2			Po 210	6.35E-10	CC 2		
Zn 65					Ra 223				
Se 79	1.66E-06	CC 2			Ra 225				
Kr 81					Ra 226	1.95E-09	CC 2		
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	1.80E+00	CC 2			Th 227				
Zr 93	2.04E-03	CC 2			Th 228				
Nb 91					Th 229	1.44E-11	CC 2		
Nb 92					Th 230	2.23E-07	CC 2		
Nb 93m	1.86E-03	CC 2			Th 232				
Nb 94	4.43E-03	CC 2			Th 234				
Mo 93	3.41E-04	CC 2			Pa 231	1.59E-08	CC 2		
Tc 97					Pa 233				
Tc 99	1.85E-02	CC 2			U 232				
Ru 106	3.52E-12	CC 2			U 233	4.31E-09	CC 2		
Pd 107					U 234	7.03E-04	CC 2		
Ag 108m					U 235	1.90E-05	CC 2		
Ag 110m					U 236	5.58E-05	CC 2		
Cd 109					U 238	1.97E-04	CC 2		
Cd 113m					Np 237	2.21E-05	CC 2		
Sn 119m					Pu 236				
Sn 121m	4.23E-03	CC 2			Pu 238	5.88E-02	CC 2		
Sn 123					Pu 239	7.11E-02	CC 2		
Sn 126	1.54E-05	CC 2			Pu 240	2.43E-02	CC 2		
Sb 125					Pu 241	4.58E-01	CC 2		
Sb 126					Pu 242	4.20E-05	CC 2		
Te 125m					Am 241	1.87E-01	CC 2		
Te 127m					Am 242m	3.02E-04	CC 2		
I 129	1.99E-06	CC 2			Am 243	1.92E-04	CC 2		
Cs 134	1.01E-07	CC 2			Cm 242	2.49E-04	CC 2		
Cs 135	4.21E-05	CC 2			Cm 243	5.30E-05	CC 2		
Cs 137	5.56E+00	CC 2			Cm 244	1.35E-03	CC 2		
Ba 133					Cm 245	6.09E-07	CC 2		
La 137					Cm 246	7.02E-05	CC 2		
La 138					Cm 248				
Ce 144	1.17E-18	CC 2			Cf 249				
Pm 145					Cf 250				
Pm 147	5.68E-06	CC 2			Cf 251				
Sm 147					Cf 252				
Sm 151	2.03E-02	CC 2			Other a	7.34E-07	CC 2		
Eu 152	2.15E-05	CC 2			Other b/g	1.19E+01	CC 2		
Eu 154	2.23E-03	CC 2			Total a	3.44E-01	CC 2	0	
Eu 155	4.48E-05	CC 2			Total b/g	3.08E+01	CC 2	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 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