

WASTE STREAM	2A311	Final Dismantling & Site Clearance : Mild Steel (Reactor) ILW
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SITE Calder Hall

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.....	0 m ³
Future arisings -	1.4.2022 - 31.3.2023.....	0 m ³
	1.4.2023 - 31.3.2024.....	0 m ³
	1.4.2024 - 31.3.2025.....	0 m ³
	1.4.2025 - 31.3.2107.....	0 m ³
	1.4.2107 - 31.3.2111.....	~654.0 m ³
Total future arisings:		654.0 m ³
Total waste volume:		654.0 m ³

Comment on volumes: For inventory purposes the arisings are assumed to arise at a uniform rate over four years. Final Dismantling & Site Clearance is assumed to commence in 2104, with reactor dismantling commencing in 2107, and lasting for ten years. Volumes and radioactivity have been calculated for 100 years after reactor shutdown, i.e. 2103, but the volume in this stream would not change for decommissioning in 2107.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 2.0
Stock (lower): x Arisings (lower) x 0.5

WASTE SOURCE Mild steel items from the reactor structure.

PHYSICAL CHARACTERISTICS

General description: A variety of mild steel items.

Physical components (%vol): Mild steel items (100%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 1.4

Comment on density: The density is of the waste as cut for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): Mild steel (includes small amounts of cast iron) (100%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: The tritium is incorporated in the steel.
C-14: The carbon 14 is incorporated in the steel. There also may be some contamination as graphite.
Cl-36: The chlorine is incorporated in the steel
Se-79: The selenium content is insignificant.
Tc-99: The chemical form of technetium has not been determined.
I-129: The iodine content is insignificant.
Ra: The radium content is insignificant.
Th: The thorium content is insignificant.
U: The uranium content is insignificant.
Np: The neptunium content is insignificant.
Pu: The plutonium content is insignificant.

Metals and alloys (%wt): All of the waste will be bulk metal items which will be cut for packaging. Metal thicknesses will probably range from a few mm to about 100 mm.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	100.0	Various grades including MEEHANITE (cast iron) and COHLO (PV).	10.0
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....			
Titanium.....			
Uranium.....	0		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	0		

Organics (%wt): No organic wastes are expected.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	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.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		

Other materials (%wt): Some graphite dust may be associated with reactor materials.

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	(%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.....			
Glass/Ceramics.....	0		
Graphite.....	TR		90.0
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): There may be trace amounts of chloride present.

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	TR	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	0	
Nitrate.....	0	
Nitrite.....	0	
Phosphate.....	0	
Sulphate.....	0	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: No materials likely to pose a fire or other non-radiological hazard have been identified.

	(%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.....		

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
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.....		
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.....		

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Complexing agents (%wt): Not yet determined

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

Potential for the waste to contain discrete items: Yes. Cast and fabricated items.

PACKAGING AND CONDITIONING

Conditioning method: The exact method of waste conditioning has not yet been established.

Plant Name: Not yet established.

Location: -

Plant startup date: -

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: 2107

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

Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
	Sellafield 3m³ box	100.0	1.33	2.8	492

Likely container type comment: -

Range in container waste volume: Waste loading estimated based on the total volume of Calder Hall FSC wastes (2A310, 2A311, 2A312 & 2A313) being packaged into 3,300 Sellafield 3m³ boxes.

Other information on containers: The packaged waste will be in a form suitable for disposal at a GDF.

Likely conditioning matrix: -

Other information: -

Conditioned density (t/m³): -

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: Not yet determined

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

RADIOACTIVITY

Source:	Activation of the mild steel and its impurities.
Uncertainty:	The values quoted were derived by calculation from available material specifications and are indicative of the activities that are to be expected. The major source of uncertainty is the impurity levels.
Definition of total alpha and total beta/gamma:	Total beta/gamma is defined as the sum of the listed activities of all nuclides other than alpha emitters. All alpha emitter activities are insignificant and the total is therefore given as $<1E-9$ TBq/m ³ .
Measurement of radioactivities:	The specific activities have been estimated using a neutron activation calculation.
Other information:	The activities quoted are those at 100 years after reactor shutdown, i.e. in 2103. There may be some contamination by Cs137.

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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			3.00E-04	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			1.00E-02	CC 2	Ho 166m				8
Na 22					Tm 170				8
Al 26					Tm 171				8
Cl 36			3.00E-06	CC 2	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41				8	Pt 193				8
Mn 53				8	Tl 204		1.00E-09	CC 2	8
Mn 54				8	Pb 205				8
Fe 55			1.00E-09	CC 2	Pb 210				8
Co 60			3.00E-05	CC 2	Bi 208				8
Ni 59			3.00E-03	CC 2	Bi 210m				8
Ni 63			7.00E-02	CC 2	Po 210				8
Zn 65				8	Ra 223				8
Se 79				8	Ra 225				8
Kr 81				8	Ra 226				8
Kr 85				8	Ra 228				8
Rb 87				8	Ac 227				8
Sr 90				8	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m				8	Th 232				8
Nb 94			3.00E-05	CC 2	Th 234				8
Mo 93			6.00E-04	CC 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			8.00E-06	CC 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			5.00E-05	CC 2	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238				8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238				8
Sn 123				8	Pu 239				8
Sn 126				8	Pu 240				8
Sb 125				8	Pu 241				8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241				8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137				8	Cm 244				8
Ba 133				8	Cm 245				8
La 137				8	Cm 246				8
La 138				8	Cm 248				8
Ce 144				8	Cf 249				8
Pm 145				8	Cf 250				8
Pm 147				8	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				8
Eu 152			2.00E-06	CC 2	Other b/g				8
Eu 154			1.00E-08	CC 2	Total a	0	<1.00E-09	C 3	
Eu 155				8	Total b/g	0	8.40E-02	CC 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