

<b>WASTE STREAM</b>	<b>2A311</b>	<b>Final Dismantling &amp; Site Clearance : Mild Steel (Reactor) ILW</b>
---------------------	--------------	--

**SITE** Calder Hall  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Sellafield Limited  
**WASTE TYPE** ILW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2108.....	0 m <sup>3</sup>
	1.4.2108 - 31.3.2112.....	654.0 m <sup>3</sup>
Total future arisings:		654.0 m <sup>3</sup>
Total waste volume:		654.0 m <sup>3</sup>

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 2105, 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 2108.

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/m<sup>3</sup>): 1.4  
 Comment on density: The density is of the waste as cut for packaging.

**CHEMICAL COMPOSITION**

General description and components (%wt): Mild steel (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.

Stainless steel.....	0	
Other ferrous metals.....	100.0	Various grades including MEEHANITE (cast iron) and COHLO (PV).
Iron.....		
Aluminium.....	0	
Beryllium.....	0	
Cobalt.....	0	

<b>WASTE STREAM</b>	<b>2A311</b>	<b>Final Dismantling &amp; Site Clearance : Mild Steel (Reactor) ILW</b>
---------------------	--------------	--

	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.	
	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.....	
	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.	
	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
	Desiccants/Catalysts.....	
	Asbestos.....	0
	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	

<b>WASTE STREAM</b>	<b>2A311</b>	<b>Final Dismantling &amp; Site Clearance : Mild Steel (Reactor) ILW</b>
---------------------	--------------	--

	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	There may be trace amounts of chloride present.	
	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.	
	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:	-	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	
	Styrene.....	
	Tri-butyl phosphate.....	
	Other organophosphates.....	

<b>WASTE STREAM</b>	<b>2A311</b>	<b>Final Dismantling &amp; Site Clearance : Mild Steel (Reactor) ILW</b>
---------------------	--------------	--

Vinyl chloride.....  
 Arsenic.....  
 Barium.....  
 Boron.....  
 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): Not yet determined  
     EDTA.....  
     DPTA.....  
     NTA.....  
     Polycarboxylic acids.....  
     Other organic complexants.....  
     Total complexing agents..... NE

**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 (m<sup>3</sup>/y incoming waste): -  
 Target start date for packaging this stream: 2108  
 Throughput for this stream (m<sup>3</sup>/y incoming waste): -  
 Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	Sellafield 3m <sup>3</sup> box	100.0	1.33	2.8	492

<b>WASTE STREAM</b>	<b>2A311</b>	<b>Final Dismantling &amp; Site Clearance : Mild Steel (Reactor) ILW</b>
---------------------	--------------	--

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/m<sup>3</sup>): -

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: Not yet determined

Treatment	Stream volume (%)	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<sup>3</sup>.

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.

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

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			3.00E-04	C C 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			1.00E-02	C C 2	Ho 166m				8
Na 22					Tm 170				8
Al 26					Tm 171				8
Cl 36			3.00E-06	C C 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	C C 2	
Mn 54				8	Pb 205				8
Fe 55			1.00E-09	C C 2	Pb 210				8
Co 60			3.00E-05	C C 2	Bi 208				8
Ni 59			3.00E-03	C C 2	Bi 210m				8
Ni 63			7.00E-02	C C 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	C C 2	Th 234				8
Mo 93			6.00E-04	C C 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			8.00E-06	C C 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			5.00E-05	C C 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	C C 2	Other b/g				8
Eu 154			1.00E-08	C C 2	<b>Total a</b>	<b>0</b>	<b>&lt;1.00E-09</b>	<b>C 3</b>	
Eu 155				8	<b>Total b/g</b>	<b>0</b>	<b>8.00E-02</b>	<b>C C 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