

WASTE STREAM	2A313	Final Dismantling & Site Clearance : Miscellaneous Metal (Reactor) ILW
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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 ³
Future arisings -	1.4.2019 - 31.3.2108.....	0 m ³
	1.4.2108 - 31.3.2112.....	21.2 m ³
Total future arisings:		21.2 m ³
Total waste volume:		21.2 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 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 A variety of miscellaneous metallic wastes resulting from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: Reactor components including control rods, zirconium thimble tubes, CGO thermocouples, core thermocouples and thermocouple ducts. Calder reactors have no channel sleeves or tie rods.
 Physical components (%wt): Boron Steel control rods (~95%wt), zirconium thimble tubes (~5% wt). Calder reactors have no channel sleeves or tie rods.
 Sealed sources: The waste does not contain sealed sources.
 Bulk density (t/m³): 1
 Comment on density: The density is of the waste as prepared for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): Boron steel (~95%wt), zirconium (~5%wt), alumel (<1% wt) and chromel (<1%wt).

Chemical state: Neutral

Chemical form of radionuclides: H-3: The tritium content is insignificant.
 C-14: The chemical form of carbon 14 has not been assessed but may be graphite.
 Cl-36: The chlorine content is insignificant
 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): -

Stainless steel.....	0	
Other ferrous metals.....	~95.0	Boron steel.
Iron.....		
Aluminium.....		
Beryllium.....	0	
Cobalt.....	0	
Copper.....		

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	Lead.....	0	
	Magnox/Magnesium.....	0	
	Nickel.....	<1.0	Chromel and alumel are both present at 0.45% w/w.
	Titanium.....		
	Uranium.....	0	
	Zinc.....	0	
	Zircaloy/Zirconium.....	~5.0	
	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.....		

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	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	Trace quantities of chloride may be 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:

	-	
	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.....

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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 (m³/y incoming waste): -
 Target start date for packaging this stream: 2108
 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 3m ³ box	100.0	1.33	2.8	16

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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

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source:

Activation of the materials and impurities. There may be some contamination.

Uncertainty:

The values quoted were derived by calculation from available material specification and are indicative of the activities that are expected. The major source of uncertainty is the impurity levels.

Definition of total alpha and total beta/gamma:

All alpha emitters activities are insignificant and the total is therefore given as <1E-9 TBq/m³. An estimate of total beta/gamma activity is provided, individual nuclide activities have not been quantified.

Measurement of radioactivities:

The specific activities have been estimated using a neutron activation calculation using available material specifications. The major source of uncertainty is the impurity levels.

Other information:

There may be some contamination by Cs137. The activities quoted are those at 100 years after reactor shutdown, i.e. in 2103.

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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				8
Be 10				8	Ho 163				8
C 14			3.00E-03	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26			4.00E-07	C C 2	Tm 171				8
Cl 36				8	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				8
Mn 54				8	Pb 205				8
Fe 55				8	Pb 210				8
Co 60			2.00E-04	C C 2	Bi 208				8
Ni 59			1.00E-01	C C 2	Bi 210m				8
Ni 63			6.00E+00	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			2.00E-03	C C 2	Th 234				8
Mo 93			1.00E-03	C C 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			1.00E-05	C C 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			1.00E-04	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				6	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				8	Other b/g				8
Eu 154				8	Total a	0	<1.00E-09	C 3	
Eu 155				8	Total b/g	0	6.00E+00	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