

WASTE STREAM	9G312	Miscellaneous Metal (Reactor) ILW
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SITE Trawsfynydd
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m ³
Future arisings -	1.4.2074 - 31.3.2083.....	10.3 m ³
Total future arisings:		10.3 m ³
Total waste volume:		10.3 m ³

Comment on volumes: For inventory purposes the arisings are assumed to arise at a uniform rate over 9 years. Final Dismantling & Site Clearance is assumed to commence in 2074. Volumes and radioactivity have been calculated for 85 years after reactor shutdown.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.2
 Stock (lower): x Arisings (lower) x 0.8

WASTE SOURCE Miscellaneous metallic wastes resulting from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: Boron steel control rods and Magnox seals.
 Physical components (%wt): Boron steel control rods (82%wt), Magnox seals (18% wt).
 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): Boron steel (82%wt), Magnox incorporating zirconium (18% wt).

Chemical state: Neutral

Chemical form of radionuclides: H-3: The tritium content is insignificant.
 C-14: Carbon 14 is incorporated in the Magnox. There may be some graphite contamination.
 Cl-36: The chlorine 36 content is insignificant.
 Se-79: The selenium content is insignificant.
 Tc-99: The chemical form of technetium has not been determined.
 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 have been cut, if necessary, to fit a standard ILW package.

Stainless steel.....	0	
Other ferrous metals.....	82.0	boron steel.
Iron.....		
Aluminium.....	NE	
Beryllium.....	TR	
Cobalt.....	<0.04	Greatest measured value from the various components.
Copper.....	NE	
Lead.....	NE	
Magnox/Magnesium.....	18.0	
Nickel.....		

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	Titanium.....		
	Uranium.....		
	Zinc.....	NE	
	Zircaloy/Zirconium.....	P	Zirconium is present in the Magnox.
	Other metals.....	TR	Silver and niobium.
Organics (%wt):	None expected. There are no halogenated plastics or rubbers present.		
	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):	There may be traces of graphite.		
	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.....		
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	

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Inorganic anions (%wt):

The waste may include traces of chloride.

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:

Magneox will ignite under certain conditions.

Combustible metals..... 18.0

Low flash point liquids..... 0

Explosive materials..... 0

Phosphorus..... 0

Hydrides..... 0

Biological etc. materials..... 0

Biodegradable materials.....

Putrescible wastes..... 0

Non-putrescible wastes.....

Corrosive materials..... 0

Pyrophoric materials..... 0

Generating toxic gases..... 0

Reacting with water..... 18.0

Active particles.....

Soluble solids as bulk chemical
compounds.....Hazardous substances /
non hazardous pollutants:

None expected.

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

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Likely container type comment: The waste is assumed to be in baskets in the waste package so the occupied volume in the package is greater than the original waste volume. Container choice may be influenced by Transport Regulations at the time of final site clearance.

Range in container waste volume: Not yet determined. No significant variability is expected.

Other information on containers: The container material is expected to be stainless steel.

Likely conditioning matrix: Blast Furnace Slag / Ordinary Portland Cement

Other information: The waste is assumed to be encapsulated.

Conditioned density (t/m³): ~3.0

Conditioned density comment: The conditioned waste density assumes that the waste will be encapsulated.

Other information on conditioning: The waste will be in baskets placed in the waste packages. Baskets of different Final Dismantling & Site Clearance ILW wastes may be in the same waste package. The encapsulation matrix is likely to be BFS/OPC and the density of the conditioned waste product would be about 3 t/m³. The volume of this stream is small and will not fill one box. Data have been presented as if the waste will be placed in a container with other ILW.

Opportunities for alternative disposal routing: No

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source: Activation of the metals and impurities.

Uncertainty: The values quoted were derived by calculation from available material specifications 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: 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.

Measurement of radioactivities: The specific activities were estimated from neutron activation calculations of the material and its impurities.

Other information: The activities quoted are those at 85 years after reactor shutdown, i.e. in 2074. 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 1.4.2019	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			2.82E-02	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			1.15E-03	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			2.72E-05	CC 2	Pt 193				8
Mn 53				8	Tl 204		2.88E-09	CC 2	8
Mn 54				8	Pb 205				8
Fe 55			3E-09	CC 2	Pb 210				8
Co 60			2.6E-03	CC 2	Bi 208				8
Ni 59			1.53E-02	CC 2	Bi 210m				8
Ni 63			1.09E+00	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			2.3E-09	CC 2	Th 230				8
Nb 93m				6	Th 232				8
Nb 94			2.09E-03	CC 2	Th 234				8
Mo 93			1.51E-04	CC 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			3.02E-05	CC 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			6.22E-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			2.47E-03	CC 2	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				
Eu 152				8	Other b/g				
Eu 154			2.35E-05	CC 2	Total a	0	0		
Eu 155			8.69E-08	CC 2	Total b/g	0	1.14E+00	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