

WASTE STREAM	9J316	Miscellaneous Metals (Reactor) ILW
---------------------	--------------	---

SITE Hunterston A
SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: Yes

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m ³
Future arisings -	1.4.2075 - 31.3.2080.....	6.8 m ³
Total future arisings:		6.8 m ³
Total waste volume:		6.8 m ³

Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 5 years. Final Dismantling & Site Clearance is assumed to commence in 2071 with reactor dismantling commencing in 2075 and lasting for 5 years. The volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2075.

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

WASTE SOURCE A variety of miscellaneous metallic wastes from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: Reactor components including control rods, specimen tubes and core thermocouples.

Physical components (%wt): Boron steel from control rods, shielding and emergency shutdown system (96%wt), magnox specimen tubes (3%wt), and chromel and alumel (<1%wt).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.4

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

CHEMICAL COMPOSITION

General description and components (%wt): A variety of metals including Boron steel (96%wt), Magnox (3%wt), chromel (<1%wt) and alumel (<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 36 content is insignificant.
 Se-79: The selenium content is insignificant.
 Tc-99: Technetium will be incorporated in the metal. It is an activation product of Mo-98.
 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): Items will be cut for packaging, but an assessment of the item dimensions has not been made.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	~96.0		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....			

WASTE STREAM	9J316	Miscellaneous Metals (Reactor) ILW
---------------------	--------------	---

Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	~3.0	
Nickel.....	<2.0	Chromel (<1%wt) and alamel (<1%wt)
Titanium.....		
Uranium.....		
Zinc.....	0	
Zircaloy/Zirconium.....	0	
Other metals.....		

Organics (%wt): None expected. Halogenated plastics and halogenated rubbers are not expected.

	(%wt)	Type(s) and comment	% of total C14 activity
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.

	(%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		
Desiccants/Catalysts.....			

WASTE STREAM	9J316	Miscellaneous Metals (Reactor) ILW
---------------------	--------------	---

Asbestos.....	0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): Not fully assessed.

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

Materials of interest for waste acceptance criteria: Some Magnox is expected in the waste.

	(%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.....		
Putrescible wastes.....	0	
Non-putrescible wastes.....		
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	3.0	
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.....

Complexing agents (%wt):

	(%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. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs. NB If recycled then DI Limits n/a

WASTE STREAM**9J316****Miscellaneous Metals (Reactor) ILW****PACKAGING AND CONDITIONING**

Conditioning method: The waste is not expected to be supercompacted. It will be placed in baskets in the waste packages and encapsulated in 4m Stainless Steel ILW Boxes.

Plant Name: None

Location: Hunterston A Decommissioning Site.

Plant startup date: 2075

Total capacity (m³/y incoming waste): ~5000.0

Target start date for packaging this stream: 2075

Throughput for this stream (m³/y incoming waste): ~0.8

Other information: The waste will be packaged immediately after the plant is dismantled. It will be placed in basket and encapsulated. Basket of different ILW waste may be in the same package.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	4m box (100mm concrete shielding)	100.0	12.3	14.3	< 1

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 to be encapsulated.

Conditioned density (t/m³): ~3.0

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

Other information on conditioning: The waste will be cut for packaging and placed into baskets. Baskets of different Final Dismantling and Site Clearance ILW wastes may be placed in the same package. Should encapsulation not be required the density of the waste product would be about 1.2 t/m³. The volume of this stream is small and will only fill one or two boxes. It is likely that the waste will be placed in containers with other ILW.

Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	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 specifications and are indicative of the activities that are expected. The major source of uncertainty is the impurity levels.

WASTE STREAM**9J316****Miscellaneous Metals (Reactor) ILW**

Definition of total alpha and total beta/gamma:

Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.

Measurement of radioactivities:

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

Other information:

There may be some contamination by Cs-137. The activities quoted are those at 85 years after reactor shutdown, i.e. in 2075.

WASTE STREAM

9J316

Miscellaneous Metals (Reactor) ILW

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				8	Gd 153				8
Be 10				8	Ho 163				8
C 14			1.41E-03	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26			1E-07	CC 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		1.09E-09	CC 2	8
Mn 54				8	Pb 205				8
Fe 55			1.36E-09	CC 2	Pb 210				8
Co 60			9.1E-04	CC 2	Bi 208				8
Ni 59			9.63E-02	CC 2	Bi 210m				8
Ni 63			6.91E+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				8	Th 230				8
Nb 93m				8	Th 232				8
Nb 94			5.91E-04	CC 2	Th 234				8
Mo 93			3.61E-05	CC 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			7.45E-06	CC 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			2.4E-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				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				
Eu 152				8	Other b/g				
Eu 154				8	Total a	0	0		
Eu 155				8	Total b/g	0	7.01E+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