

WASTE STREAM	9D313	Miscellaneous Metal (Reactor) ILW
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SITE Hinkley Point A
SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox 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 -	1.4.2085 - 31.3.2088.....	12.0 m ³
Total future arisings:		12.0 m ³
Total waste volume:		12.0 m ³

Comment on volumes: For inventory purposes the arisings are assumed to arise at a uniform rate over three years. Final Dismantling & Site Clearance is assumed to commence in 2081 and end in 2090. Reactor dismantling will commence in 2085 and last for three years. Volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2085.

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 resulting from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: A variety of miscellaneous metallic items including boron steel control rods, zirconium pins, Wigner probes and thermocouples. Waste can be packaged in standard ILW packages.

Physical components (%wt): Boron steel control rods (66%wt), zirconium pins (21%wt), Magnox (~8%wt), Wigner probes (3%wt), thermocouple insulation (<1%wt)), chromel (~1%wt) 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 waste as cut for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): .A variety of metals including boron steel (66%wt), other steel (3%wt), zirconium (21%wt), Magnox (8%wt), chromel (~1%wt), alumel (~1%wt) and magnesium oxide (<1%wt).

Chemical state: Neutral

Chemical form of radionuclides: H-3: The tritium content is insignificant.
 C-14: Carbon 14 is principally incorporated in zirconium. There may be some graphite contamination.
 Cl-36: Chlorine 36 is principally incorporated in zirconium with some also in magnesium oxide associated with thermocouples.
 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): Metal thicknesses will vary up from a few mm. The maximum thickness will probably not exceed 25 mm.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	69.0		
Iron.....			
Aluminium.....	0		

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Beryllium.....	0	
Cobalt.....		
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	8.0	
Nickel.....	<2.0	Other metals are chromel (~1%wt) and alumel (~1wt%).
Titanium.....		
Uranium.....		
Zinc.....	0	
Zircaloy/Zirconium.....	21.0	
Other metals.....		

Organics (%wt): None expected. There are no halogenated plastics or rubbers present.

	(%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		

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Graphite.....	TR
Desiccants/Catalysts.....	
Asbestos.....	0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	<1.0

Inorganic anions (%wt): The waste may include traces of chloride.

	(%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: Magnox will ignite under appropriate conditions.

	(%wt)	Type(s) and comment
Combustible metals.....	~8.0	
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.....	~8.0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

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non hazardous pollutants:

Toxic metals may be present as impurities incorporated in the zirconium.

(%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): Yes

(%wt) Type(s) and comment

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Total complexing agents..... TR

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Potential for the waste to contain discrete items:

Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; All stainless items assumed DIs. NB if recycled then DI Limits n/a

PACKAGING AND CONDITIONING

Conditioning method: The waste is not expected to be supercompacted. It will be placed in baskets in the waste packages, and is now assumed to be encapsulated.

Plant Name: None

Location: Hinkley Point A Site

Plant startup date: 2085

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

Target start date for packaging this stream: 2085

Throughput for this stream (m³/y incoming waste): ~2.5

Other information: Waste will be conditioned when removed from the reactor.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	4m box (200mm concrete shielding)	100.0	9.34	10.9	2

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:

Not specified

Other information:

It is now assumed that the waste will be encapsulated. The matrix could be BFS/OPC.

Conditioned density (t/m³):

~3.0

Conditioned density comment:

The conditioned waste density now 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.

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 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.

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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 a neutron activation calculation.

Other information:

The activities quoted are those at 85 years after reactor shutdown, i.e. in 2085. 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				8	Gd 153				8
Be 10				8	Ho 163				8
C 14			1.96E-01	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26			2E-06	CC 2	Tm 171				8
Cl 36			5.41E-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			3.28E-04	CC 2	Pt 193				8
Mn 53				8	Tl 204		2.63E-08	CC 2	8
Mn 54				8	Pb 205				8
Fe 55			5.47E-08	CC 2	Pb 210				8
Co 60			1.09E-03	CC 2	Bi 208				8
Ni 59			2.64E-01	CC 2	Bi 210m				8
Ni 63			1.95E+01	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			6.98E-09	CC 2	Th 230				8
Nb 93m				6	Th 232				8
Nb 94			8.39E-04	CC 2	Th 234				8
Mo 93			4.8E-04	CC 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			8.94E-05	CC 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			1.24E-03	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			1.23E-02	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				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			5.37E-05	CC 2	Total a	0	0		
Eu 155			1.98E-07	CC 2	Total b/g	0	2.00E+01	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