

<b>WASTE STREAM</b>	<b>9E317</b>	<b>Miscellaneous Metals and Materials (Reactor and Non-Reactor) LLW</b>
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**SITE** Oldbury  
**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** LLW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	0 m <sup>3</sup>
Future arisings -	1.4.2096 - 31.3.2101.....	63.0 m <sup>3</sup>
Total future arisings:		63.0 m <sup>3</sup>
Total waste volume:		63.0 m <sup>3</sup>

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 2091 with reactor dismantling commencing in 2096 and lasting for 5 years. The volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2097.

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 materials from plant dismantling.

**PHYSICAL CHARACTERISTICS**

General description: A variety of materials including metals and temporary drains and cleaning areas.  
 Physical components (%vol): Temporary active drains (~47% vol), vacuum clean and washdown items (~53% vol), Magnox and zirconium from reactor components (<0.1% vol).  
 Sealed sources: The waste does not contain sealed sources.  
 Bulk density (t/m<sup>3</sup>): ~1  
 Comment on density: The density is of the waste as prepared for packaging and may vary in the range 0.5 - 1.5 t/m<sup>3</sup>.

**CHEMICAL COMPOSITION**

General description and components (%wt): A variety of materials including metals. Chromel, alumel and MgO will be present.

Chemical state: Neutral

Chemical form of radionuclides: H-3: The chemical form of tritium has not been assessed.  
 C-14: The chemical form of carbon 14 has not been assessed but may be graphite.  
 Cl-36: The chemical form of chlorine 36 has not been assessed.  
 Se-79: The selenium content is insignificant.  
 Tc-99: The technetium 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): Items will have been cut for packaging but an assessment of item dimensions has not been made.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE	There may be some stainless steel present as the thermocouple sheath.	
Other ferrous metals.....	0		
Iron.....			
Aluminium.....	NE		
Beryllium.....	NE		

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Cobalt.....		
Copper.....	NE	
Lead.....	NE	
Magnox/Magnesium.....	NE	
Nickel.....		
Titanium.....		
Uranium.....	NE	
Zinc.....	NE	
Zircaloy/Zirconium.....	NE	
Other metals.....	NE	Other metals will include chromel and alumel.

Organics (%wt): None expected. Halogenated rubbers are not expected. Halogenated plastics have not been estimated.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics .....	NE		
Total non-halogenated plastics.....	NE		
Condensation polymers.....	NE		
Others.....	NE		
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 might be traces of graphite

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	53.0	vacuum clean and washdown items	
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	47.0	temporary active drains	
Sand.....			
Glass/Ceramics.....	0		

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

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:           No materials likely to pose a fire or other non-radiological hazard have been identified.

	(%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.....	0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

**WASTE STREAM****9E317****Miscellaneous Metals and Materials (Reactor and Non-Reactor) LLW**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): 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 Concrete Items (LCIs) may be DIs; drummed (ungrouned)/"rubbleised" wastes assumed NOT DIs

**TREATMENT, PACKAGING AND DISPOSAL**

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		100.0

Comment on planned treatments:

-

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository		
Expected to be consigned to a Landfill Facility	100.0	1.0
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility		
Expected to be consigned to a Metal Treatment Facility		
Expected to be consigned as Out of Scope		
Expected to be recycled / reused		
Disposal route not known		

Classification codes for waste expected to be consigned to a landfill facility:

17 01 01, 16 10 01\*/16 10 02

**Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):**

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be consigned to an On-Site Disposal Facility			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be consigned as Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

**Opportunities for alternative disposal routing:** -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

**Waste Packaging for Disposal:** (Not applicable to this waste stream)

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Container	Stream volume %	Waste loading m <sup>3</sup>	Number of packages
1/3 Height IP-1 ISO			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO			
1/2 Height IP-2 Disposal/Re-usable ISO			
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

**Waste Planned for Disposal at the LLW Repository:** (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: -

**Non-Containerised Waste for In-Vault Grouting:** (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

**RADIOACTIVITY**

Source: Activation of the materials and impurities, and contamination.

Uncertainty: Only very approximate estimates have been made of the total specific activities.

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 main source of the activity is the thermocouples. Neutron activation calculations have been made to estimate the specific activity of thermocouples.

Other information: The activities quoted are those at 85 years after reactor shutdown i.e. in 2097.

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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			1.59E-05	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			3.06E-05	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			5.28E-07	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			6.49E-06	CC 2	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55				8	Pb 210				8
Co 60			2.39E-08	CC 2	Bi 208				8
Ni 59			2.07E-08	CC 2	Bi 210m				8
Ni 63			1.28E-05	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				6	Th 232				8
Nb 94				6	Th 234				8
Mo 93			5.26E-09	CC 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				6	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m				6	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				6	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			1.15E-08	CC 2	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			8.11E-07	CC 2	Other a				
Eu 152			3.24E-06	CC 2	Other b/g				
Eu 154			5.16E-08	CC 2	<b>Total a</b>	<b>0</b>		<b>0</b>	
Eu 155				8	<b>Total b/g</b>	<b>0</b>		<b>7.05E-05</b>	<b>CC 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