

<b>WASTE STREAM</b>	<b>9E104</b>	<b>Care &amp; Maintenance : Dry Fuel Route 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 - 1.4.2033 - 31.3.2093.....	120.0 m <sup>3</sup>
Total future arisings:	120.0 m <sup>3</sup>
Total waste volume:	120.0 m <sup>3</sup>

Comment on volumes: Arisings are assumed to be approximately 2m<sup>3</sup> per year for each of the years of Care & Maintenance. Care & Maintenance is assumed to start at the end of 2033 after Care & Maintenance Preparation has been completed.

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

**WASTE SOURCE** Wastes from the general reactor area during the Care and Maintenance period.

**PHYSICAL CHARACTERISTICS**

General description: Principally mixed plastic sheeting and protective clothing all in mild steel drums. Any items will be cut to fit standard packages.

Physical components (%wt): Principally plastic and cloth (~75%wt), all in mild steel drums (~25%wt).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~0.4

Comment on density: The density estimate may be subject to revision.

**CHEMICAL COMPOSITION**

General description and components (%wt): The waste comprises principally various plastics and cloth, all in mild steel drums. Steel drum approximately 25%wt, percentage breakdown of other components not assessed.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium present as surface contamination of waste by tritiated water.  
 C-14: Contamination in the form of graphite dust.  
 Cl-36: Chlorine 36 may be present as a contaminant of graphite dust.  
 Se-79: The selenium content is insignificant.  
 Tc-99: The technetium content is insignificant.  
 Ra: The radium isotope content is insignificant.  
 Th: The thorium isotope content is insignificant.  
 U: The chemical form of uranium isotopes has not been determined but may be uranium oxides.  
 Np: The neptunium content is insignificant.  
 Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Bulk and sheet metal are not expected to be present in significant quantities and have not been assessed. Mild steel drums containing the waste will arise at about 10 per year.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	25.0		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		

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Cobalt.....		
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	0	
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....	0	
Zircaloy/Zirconium.....	0	
Other metals.....	0	"Other" metals have not been identified.

Organics (%wt): To be determined.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~37.0		
Paper, cotton.....	~37.0		
Wood.....	NE		
Halogenated plastics .....	~38.0		
Total non-halogenated plastics.....	NE		
Condensation polymers.....	NE		
Others.....	NE		
Organic ion exchange materials....	0		
Total rubber.....	NE		
Halogenated rubber .....	NE		
Non-halogenated rubber.....	NE		
Hydrocarbons.....			
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		

Other materials (%wt): -

	(%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.....	NE		
Graphite.....	0		

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

Inorganic anions (%wt):           None expected, but possibly present in trace quantities.

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

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.....		

Hazardous substances /  
non hazardous pollutants:      None expected

	(%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	

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Potential for the waste to contain discrete items: No.

**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	Off-site	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 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	100.0	0.40

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

**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 and contamination of materials.

Uncertainty: Activity values are current best estimates. Specific activity is a function of Station operating history. The values quoted are indicative of the activities that would be expected.

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 have been assumed to be the same as Operational waste for Dry Fuel Route LLW and decayed until the start of Care & Maintenance.

Other information: Activity estimates are as shown in the table.

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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			2.86E-04	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			3E-05	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			1E-04	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				8	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55			4.37E-06	CC 2	Pb 210				8
Co 60			3.18E-06	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			6.71E-06	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			2.6E-07	CC 2	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				8	Th 234		7E-09		8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234		6E-09	CC 2	
Ag 108m				8	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238		7E-09	CC 2	
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		9.54E-09	CC 2	
Sn 123				8	Pu 239		2E-08	CC 2	
Sn 126				8	Pu 240		2E-08	CC 2	
Sb 125			1.33E-09	CC 2	Pu 241		5.24E-07	CC 2	
Sb 126				8	Pu 242				8
Te 125m				8	Am 241		6.52E-08	CC 2	
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134			1.34E-08	CC 2	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137			6.97E-07	CC 2	Cm 244				8
Ba 133			6.75E-09	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			1.23E-08	CC 2	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				
Eu 152			5.15E-08	CC 2	Other b/g				
Eu 154			6.16E-08	CC 2	<b>Total a</b>	<b>0</b>	<b>1.28E-07</b>	<b>CC 2</b>	
Eu 155			4.24E-09	CC 2	<b>Total b/g</b>	<b>0</b>	<b>4.31E-04</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