

<b>WASTE STREAM</b>	<b>5G24</b>	<b>Winfrith LLW Sources</b>
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**SITE** Winfrith  
**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.....	<< 0.1 m <sup>3</sup>
Future arisings -	1.4.2034 - 31.3.2035.....	< 0.1 m <sup>3</sup>
Total future arisings:		< 0.1 m <sup>3</sup>
Total waste volume:		< 0.1 m <sup>3</sup>

Comment on volumes: A small number of sources maybe disposed of prior to 2034. A full review of remaining sources on site has been carried out. A total of 79 LLW sources remain on site of which 13 are redundant and 66 are still in use. The stream is to be updated to reflect this using the common volume assumption per source of 0.0002m<sup>3</sup> per source (10cm x 10cm x 2cm).

Uncertainty factors on volumes: Stock (upper): x 1.1 Arisings (upper) x 1.1  
 Stock (lower): x 0.9 Arisings (lower) x 0.9

**WASTE SOURCE** LLW sources arising from operations and experiments on the site.

**PHYSICAL CHARACTERISTICS**

General description: The sources will be varying sizes, and packaging will vary from plastic sealed/wrapped, concreted into a metal/plastic bin, cardboard box etc.

Physical components (%vol): Sources and immediate shielding (80%) miscellaneous items

Sealed sources: The waste contains sealed sources. A total of 79 LLW sources remain on site of which 13 are redundant and 66 are still in use.

Bulk density (t/m<sup>3</sup>): ~1

Comment on density: Density refers to sources on bases only, when they have been stripped of all extraneous materials, which are disposed of as non-active material. Redundant sources will then be encapsulated for disposal as LLW.

**CHEMICAL COMPOSITION**

General description and components (%wt): Sources (79%), unspecified and ferrous metals (12%), plastics (7%), others (2%). Sources will comprise metal/ plastic/ mica holders and source material.

Chemical state: Neutral

Chemical form of radionuclides: C-14: Present as labelled organic compounds  
 U: Metal or oxide

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~10.0		
Other ferrous metals.....	~65.0		
Iron.....			
Aluminium.....	~0.10		
Beryllium.....			
Cobalt.....			
Copper.....	TR		
Lead.....	~10.0		
Magnox/Magnesium.....			

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Nickel.....			
Titanium.....			
Uranium.....	P		
Zinc.....	0		
Zircaloy/Zirconium.....			
Other metals.....	~1.0	Tungsten and Depleted Uranium	
Organics (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~0.90		
Paper, cotton.....	~0.90		
Wood.....	0		
Halogenated plastics .....	~1.0	PVC is expected to be present together with small amounts of PTFE, neoprene and hypalon.	
Total non-halogenated plastics.....	~10.0		
Condensation polymers.....	NE		
Others.....	~10.0		
Organic ion exchange materials....	0		
Total rubber.....	TR		
Halogenated rubber .....	TR	neoprene	
Non-halogenated rubber.....	TR		
Hydrocarbons.....			
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	NE		
Other materials (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..			
Inorganic sludges and flocs.....			
Soil.....			
Brick/Stone/Rubble.....			
Cementitious material.....			
Sand.....			
Glass/Ceramics.....	~0.80		
Graphite.....			
Desiccants/Catalysts.....			
Asbestos.....	NE		
Non/low friable.....			

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Moderately friable.....

Highly friable.....

Free aqueous liquids..... NE

Free non-aqueous liquids..... NE

Powder/Ash..... NE

Inorganic anions (%wt):            Inorganic anions are not expected to be present in significant quantities

	(%wt)	Type(s) and comment
Fluoride.....	<0.01	
Chloride.....	<0.01	
Iodide.....	<0.01	
Cyanide.....	0	
Carbonate.....	<0.10	
Nitrate.....	<0.10	
Nitrite.....	<0.10	
Phosphate.....	<0.10	
Sulphate.....	<0.10	
Sulphide.....	<0.10	

Materials of interest for waste acceptance criteria:            -

	(%wt)	Type(s) and comment
Combustible metals.....	~2.0	
Low flash point liquids.....	~0.50	
Explosive materials.....	<0.01	
Phosphorus.....	<0.01	
Hydrides.....	<0.01	
Biological etc. materials.....	<0.10	
Biodegradable materials.....	0.01	
Putrescible wastes.....	<0.01	
Non-putrescible wastes.....		
Corrosive materials.....	<0.01	
Pyrophoric materials.....	<0.01	
Generating toxic gases.....	<0.01	
Reacting with water.....	<0.01	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / non hazardous pollutants:            -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		

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Formaldehyde.....  
 Organometallics.....  
 Phenol.....  
 Styrene.....  
 Tri-butyl phosphate.....  
 Other organophosphates.....  
 Vinyl chloride.....  
 Arsenic.....  
 Barium.....  
 Boron..... 0  
     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.....		

Potential for the waste to contain discrete items:      Not yet determined. Subject to DI type assessment (specific clauses within WAC)

**TREATMENT, PACKAGING AND DISPOSAL**

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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	On-site	100.0

Comment on planned treatments:

Sources will be stripped of all extraneous material and encapsulated in grout in "paint-tin" type containers.

**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	2.4

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:**

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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	100.0	~15.5	< 1

Other information:                      Only one paint-tin type container is allowed per disposal container for sealed sources. It is expected that this stream will be disposed with other LLW streams. Waste will not be drummed and supercompacted but encapsulated into 100ml grout.

**Waste Planned for Disposal at the LLW Repository:**

Container voidage:                      Significant inaccessible voidage is not expected.

Waste Characterisation Form (WCH):                      The waste meets the LLWR's Waste Acceptance Criteria (WAC).  
The waste does not have a current 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:                                      Sources

Uncertainty:                              Radionuclides expected to be present shown in above table.

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:                      Data taken from source register decayed to 01/04/2022 for stocks (redundant) and 01/04/2034 (future arisings still in use).

Other information:                      -

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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		4	5.6E-06	BB 1	Gd 153		4		4
Be 10		4		4	Ho 163		4		4
C 14		4	2.69E-05	BB 1	Ho 166m		4		4
Na 22		4		4	Tm 170		4		4
Al 26		4		4	Tm 171		4		4
Cl 36		4	5.82E-06	BB 1	Lu 174		4		4
Ar 39		4		4	Lu 176		4	5E-05	BB 1
Ar 42		4		4	Hf 178n		4		4
K 40		4		4	Hf 182		4		4
Ca 41		4		4	Pt 193		4		4
Mn 53		4		4	Tl 204		4		4
Mn 54		4		4	Pb 205		4		4
Fe 55		4		4	Pb 210		4		4
Co 60		4	1.61E-05	BB 1	Bi 208		4		4
Ni 59		4		4	Bi 210m		4		4
Ni 63		4		4	Po 210		4		4
Zn 65		4		4	Ra 223		4		4
Se 79		4		4	Ra 225		4		4
Kr 81		4		4	Ra 226		4	6.54E-04	BB 1
Kr 85		4		4	Ra 228		4		4
Rb 87		4		4	Ac 227		4		4
Sr 90	2.78E-08	BB 1	5.14E-06	BB 1	Th 227		4		4
Zr 93		4		4	Th 228		4		4
Nb 91		4		4	Th 229		4		4
Nb 92		4		4	Th 230		4		4
Nb 93m		4		4	Th 232		4		4
Nb 94		4		4	Th 234		4		4
Mo 93		4		4	Pa 231		4		4
Tc 97		4		4	Pa 233		4		4
Tc 99		4		4	U 232		4		4
Ru 106		4		4	U 233		4		4
Pd 107		4		4	U 234		4		4
Ag 108m		4		4	U 235	1.39E-04	BB 1	1.77E-05	BB 1
Ag 110m		4		4	U 236		4		4
Cd 109		4		4	U 238		4		4
Cd 113m		4		4	Np 237		4		4
Sn 119m		4		4	Pu 236		4		4
Sn 121m		4		4	Pu 238		4		4
Sn 123		4		4	Pu 239		4	6.02E-05	BB 1
Sn 126		4		4	Pu 240		4		4
Sb 125		4		4	Pu 241		4		4
Sb 126		4		4	Pu 242		4		4
Te 125m		4		4	Am 241		4	5.76E-06	BB 1
Te 127m		4		4	Am 242m		4		4
I 129		4		4	Am 243		4	4.98E-06	BB 1
Cs 134		4		4	Cm 242		4		4
Cs 135		4		4	Cm 243		4		4
Cs 137		4	2.22E-03	BB 1	Cm 244		4		4
Ba 133		4		4	Cm 245		4		4
La 137		4		4	Cm 246		4		4
La 138		4		4	Cm 248		4		4
Ce 144		4		4	Cf 249		4		4
Pm 145		4		4	Cf 250		4		4
Pm 147		4		4	Cf 251		4		4
Sm 147		4		4	Cf 252		4		4
Sm 151		4		4	Other a				
Eu 152		4	7.49E-02	BB 1	Other b/g				
Eu 154		4		4	<b>Total a</b>	<b>1.39E-04</b>	<b>BB 1</b>	<b>7.43E-04</b>	<b>BB 1</b>
Eu 155		4		4	<b>Total b/g</b>	<b>2.78E-08</b>	<b>BB 1</b>	<b>7.72E-02</b>	<b>BB 1</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