

<b>WASTE STREAM</b>	<b>5G308</b>	<b>Legacy Decommissioning LLW</b>
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**SITE** Winfrith  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Magnox Limited  
**WASTE TYPE** LLW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	190.0 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>
Total waste volume:		190.0 m <sup>3</sup>

Comment on volumes: Volume reassessed since 2013 UKRWI and now aligned with stock spreadsheet and LTP data. Historic wastes arising from previous operations and decommissioning of various Winfrith facilities (most notably SGHWR and DRAGON). This waste is subject to an ongoing programme of characterisation with the objective of identifying appropriate disposal routes.

Uncertainty factors on volumes: Stock (upper): x 1.5 Arisings (upper) x  
 Stock (lower): x 0.5 Arisings (lower) x

**WASTE SOURCE** Various facilities at the Winfrith site including DRAGON, SGHWR, ZEBRA, EAST, WETP, ALES, A50 and A51

**PHYSICAL CHARACTERISTICS**

General description: Waste is varied and includes bulk items and drummed wastes.  
 Physical components (%vol): Physical composition very variable.  
 Sealed sources: -  
 Bulk density (t/m<sup>3</sup>): ~1.28  
 Comment on density: Recorded mass and envelope volumes of wastes as-stored.

**CHEMICAL COMPOSITION**

General description and components (%wt): Mainly metal (93%) Concrete (1%), plus plastic (3%), rubber (1%), biodegradables (1%) and others (1%) including spent shot / paint / rust mixture from the WACM process, Beryllium contaminated soft wastes, Mercury and mercury contaminated wastes and Oil and oily wastes (~0.5%)

Chemical state: -

Chemical form of radionuclides: -

Metals and alloys (%wt): -

Stainless steel.....	~18.0	Tank pieces, pipework,
Other ferrous metals.....	~63.5	Drums (TC-19), plant, pipes, plate metal, vessels
Iron.....		
Aluminium.....	~0.80	solid (plant/vessel components, building wire, sheathing)
Beryllium.....	~0.10	Contamination PPE / Soft Waste
Cobalt.....		
Copper.....		
Lead.....	~5.0	Shielding blocks
Magnox/Magnesium.....		
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....		

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	Zircaloy/Zirconium.....	0	
	Other metals.....	~5.5	
Organics (%wt):	-		
	Total cellulose.....	0	
	Paper, cotton.....		
	Wood.....		
	Halogenated plastics .....	~1.0	PVC
	Total non-halogenated plastics.....	~2.0	
	Condensation polymers.....	~1.0	
	Others.....	~1.0	
	Organic ion exchange materials....	0	
	Total rubber.....	~1.0	
	Halogenated rubber .....	~0.50	Neoprene
	Non-halogenated rubber.....	~0.50	
	Hydrocarbons.....	~0.50	
	Oil or grease .....	~0.50	
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	P	
Other materials (%wt):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....		
	Brick/Stone/Rubble.....		
	Cementitious material.....	~1.0	
	Sand.....		
	Glass/Ceramics.....	0	
	Graphite.....	0	
	Desiccants/Catalysts.....		
	Asbestos.....		There is likely to be some quantity of asbestos present.
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....		
	Powder/Ash.....	NE	
Inorganic anions (%wt):	Anions may be present as components of soil and cement		

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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:

Oil and grease content at <0.5% (no liquid oil or grease content other than surface smearing, no visible oil or grease released by leaching). Some waste associated with the sewage plant (ALES) containing traces of very well rotted, dried, active sewage sludge will be present at <2% (expected to meet CFA requirements).

Combustible metals.....	0
Low flash point liquids.....	0
Explosive materials.....	0
Phosphorus.....	0
Hydrides.....	0
Biological etc. materials.....	
Biodegradable materials.....	~1.0
Putrescible wastes.....	~1.0
Non-putrescible wastes.....	0
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Active particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances / non hazardous pollutants:

Certain items contain beryllium metal, asbestos, cadmium and traces of mercury.

Acrylamide.....	
Benzene.....	
Chlorinated solvents.....	
Formaldehyde.....	
Organometallics.....	
Phenol.....	
Styrene.....	
Tri-butyl phosphate.....	
Other organophosphates.....	
Vinyl chloride.....	
Arsenic.....	
Barium.....	

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Boron.....  
 Cadmium.....  
 Caesium.....  
 Selenium.....  
 Chromium.....  
 Molybdenum.....  
 Thallium.....  
 Tin.....  
 Vanadium.....

Mercury compounds..... -0.10

Contamination PPE / Soft Waste / Swabs

Others.....

Electronic Electrical Equipment (EEE)

EEE Type 1..... P

30 off Old computers, disc drives, monitors, obsolete HP portable monitoring equipment, etc, from active work areas.

EEE Type 2..... P

20 off Electrical controls / systems for disused supercompactor.

EEE Type 3..... P

5 off A limited amount of tooling from characterisation / size reduction of legacy wastes (drills, saws).

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt):

No

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Total complexing agents..... 0

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	Off-site	10.0
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		~90.0

Comment on planned treatments:

76% of this stream is expected to be disposed of as VLLW to landfill

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Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	14.0
Expected to be consigned to a Landfill Facility	76.0
Expected to be consigned to an On-Site Disposal Facility	
Expected to be consigned to an Incineration Facility	10.0
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	

**Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):**

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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			

**Waste Packaging for Disposal:**

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	~14.0	~10	3
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

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

Container voidage: Inaccessible voidage &lt; 10% payload volume.

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).  
The waste has a current WCH.

Individual WCFs will be submitted for approval for discreet campaigns of waste as and when the waste is characterised

Waste consigned for disposal to LLWR in year of generation: No. Majority of wastes have been in temporary storage at Winfrith for less than 10 years

Potential for the waste to contain discrete items: -

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

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

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Other information:

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**RADIOACTIVITY**

Source:

The waste could contain fission products and/or activation products.

Uncertainty:

-

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 WCH 1MXN-2WIN-0-WCH-0-4240 and decayed by 2 years to 2019

Other information:

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	1.44E-05	CC 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	4.26E-08	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			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	2.54E-09	CC 2			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	2.86E-08	CC 2			Pb 210		8		
Co 60	8.92E-07	CC 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63	5.96E-06	CC 2			Po 210		8		
Zn 65		8			Ra 223	9.25E-09	CC 2		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228	8.61E-09	CC 2		
Rb 87		8			Ac 227	9.81E-09	CC 2		
Sr 90	1.87E-05	CC 2			Th 227	9.33E-09	CC 2		
Zr 93	1.01E-09	CC 2			Th 228	2.1E-08	CC 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	4.02E-08	CC 2		
Nb 93m		8			Th 232	4.02E-08	CC 2		
Nb 94		8			Th 234	2.66E-07	CC 2		
Mo 93		8			Pa 231	1.59E-07	CC 2		
Tc 97		8			Pa 233	4.79E-08	CC 2		
Tc 99		8			U 232		8		
Ru 106		8			U 233	1.69E-06	CC 2		
Pd 107		8			U 234	4.14E-07	CC 2		
Ag 108m		8			U 235	9.39E-08	CC 2		
Ag 110m		8			U 236	1.9E-09	CC 2		
Cd 109		8			U 238	2.66E-07	CC 2		
Cd 113m		8			Np 237	4.79E-08	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	7.22E-07	CC 2		
Sn 123		8			Pu 239	2.63E-05	CC 2		
Sn 126		8			Pu 240	5.37E-06	CC 2		
Sb 125	1.78E-09	CC 2			Pu 241	4.17E-05	CC 2		
Sb 126		8			Pu 242	1.83E-09	CC 2		
Te 125m		8			Am 241	6.94E-06	CC 2		
Te 127m		8			Am 242m		8		
I 129	3.65E-09	CC 2			Am 243	2.25E-08	CC 2		
Cs 134		8			Cm 242		8		
Cs 135		8			Cm 243	2.18E-07	CC 2		
Cs 137	4.88E-05	CC 2			Cm 244	3.82E-07	CC 2		
Ba 133		8			Cm 245	2.24E-08	CC 2		
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	2.2E-08	CC 2			<b>Total a</b>	<b>4.28E-05</b>	<b>CC 2</b>	<b>0</b>	
Eu 155		8			<b>Total b/g</b>	<b>1.31E-04</b>	<b>CC 2</b>	<b>0</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