

WASTE STREAM	7A116	Decommissioning LLW - Miscellaneous
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SITE AWE Aldermaston

SITE OWNER Ministry of Defence

WASTE CUSTODIAN AWE plc

WASTE TYPE LLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	18.6 m ³
Future arisings -	1.4.2022 - 31.3.2030.....	0 m ³
	1.4.2031 - 31.3.2033.....	168.0 m ³
	1.4.2034 - 31.3.2036.....	24.0 m ³
	1.4.2037 - 31.3.2045.....	0 m ³
	1.4.2046 - 31.3.2048.....	443.0 m ³
	1.4.2048 - 31.3.2080.....	0 m ³
Total future arisings:		635.0 m ³
Total waste volume:		653.6 m ³
Comment on volumes:	Future arisings are estimated based on the decommissioning for facilities on site, which have been reviewed within the past 3 years. Stock volumes are considered to be accurate. The total volume of arisings will depend on the longevity of the AWE site, with estimates being based on a site closure date of 2080.	
Uncertainty factors on volumes:	Stock (upper): x 1.0	Arisings (upper) x 5.0
	Stock (lower): x 1.0	Arisings (lower) x 0.3

WASTE SOURCE Decommissioning of reactor containing buildings and other small facilities handling miscellaneous radionuclides.

PHYSICAL CHARACTERISTICS

General description:	The waste contains metal (43.27%), cement (48.26%), concrete (7.62%), vermiculite (0.48%) and plastic (0.37%).
Physical components (%wt):	The waste contains cementitious material (55.88%), metal (43.27%), vermiculite (0.48%) and plastic (0.37%). The composition is based on the present stock (2022).
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m ³):	1.74
Comment on density:	This figure has been derived using stock data from 2022 (total stream mass divided by the total stream volume).

CHEMICAL COMPOSITION

General description and components (%wt):	The waste contains cementitious material (55.88%), metal (43.27%), vermiculite (0.48%) and plastic (0.37%) .
Chemical state:	Neutral
Chemical form of radionuclides:	H-3: Likely to be present in future waste stream arisings in the following species: HTO, HT and organically-bound H-3. C-14: Likely to be present in future arisings as chemically bound in solid. Cl-36: Not present Se-79: Not present Tc-99: Not present I-129: Not present Ra: Likely to be daughter products present from uranium in this waste stream. Oxide form Th: Likely to be daughter products present from uranium in this waste stream. Oxide form U: Likely to be present in future waste arisings in oxide form Np: Likely to be daughter products present from uranium in this waste stream. Oxide form Pu: Likely to be present in future waste arisings in oxide form
Metals and alloys (%wt):	A number of drums contain aluminum mixed with grout, with other metal contained within drums. Therefore, not considered to be bulk.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	18.9		
Other ferrous metals.....	6.4		
Iron.....	0		
Aluminium.....	10.2		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	1.2		
Lead.....	6.6		
Magnox/Magnesium.....	0		
Nickel.....	0		
Titanium.....	0		
Uranium.....	0		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	<0.01	Cadmium (<0.01%)	
Organics (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics	0.16	PVC	
Total non-halogenated plastics.....	0.21		
Condensation polymers.....	0.21		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0		
Halogenated rubber	0		
Non-halogenated rubber.....	0		
Hydrocarbons.....	0		
Oil or grease	0		
Fuel.....	0		
Asphalt/Tarmac (cont.coal tar)...	0		
Asphalt/Tarmac (no coal tar)....	0		
Bitumen.....	0		
Others.....	0		
Other organics.....	0		
Other materials (%wt):	-		

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0.48	Vermiculite (0.24%) and Fuller's Earth (0.24%)	
Cementitious material.....	55.9	SP/F4 Grout (48.26%) and concrete (7.62%)	
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....	0		
Moderately friable.....	0		
Highly friable.....	0		
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): -

	(%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: Cadmium (<1%) present in the waste.

	(%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.....	0	
Putrescible wastes.....	0	

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Non-putrescible wastes.....	0
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	0
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / non hazardous pollutants: Cadmium (<1%) present in the waste.

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	NE	
Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	
Phenol.....	NE	
Styrene.....	0	
Tri-butyl phosphate.....	0	
Other organophosphates.....	0	
Vinyl chloride.....	P	PVC
Arsenic.....	NE	
Barium.....	0	
Boron.....	NE	
Boron (in Boral).....	NE	
Boron (non-Boral).....	0	
Cadmium.....	NE	
Caesium.....	TR	
Selenium.....	NE	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....	0	
Tin.....	NE	
Vanadium.....	NE	
Mercury compounds.....	0	
Others.....	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	0	
EEE Type 2.....	0	
EEE Type 3.....	0	
EEE Type 4.....	0	
EEE Type 5.....	0	

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....	0	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids.....	TR	Traces of complexing agents will be present because of their use as decontaminants.
Other organic complexants.....	TR	
Total complexing agents.....	TR	

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)	Off-site	~29.0
Incineration	Off-site	~28.0
Solidification		
Decontamination		
Metal treatment	Off-site	~23.0
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None	Off-site	~20.0

Comment on planned treatments:

Waste treatment percentages have been estimated based on predicted waste volumes and the current Corporate BAT. However, there are no new wastes predicted to enter this stream for nine years (2031), so the disposal routes may change in this time.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~29.0	>1.7
Expected to be consigned to a Landfill Facility	~20.0	>1.7
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	~28.0	<1.7
Expected to be consigned to a Metal Treatment Facility	~23.0	<1.7
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: 170106, 170107, 170201, 170202, 170203, 170409

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

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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: Not yet determined

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

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m ³	Number of packages
1/3 Height IP-1 ISO	29.0	17	12
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: Wastes going to the LLWR are expected to be supercompacted, this may not be the case.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Voidage will be low if wastes are supercompacted.

Waste Characterisation Form (WCH): The waste does not meet 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: No. Holding current in-stock wastes until resource is available to compile a WCH.

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: Uranium, plutonium, fission products and activation products.

Uncertainty: The specific activities for the stock waste is accurate and derived in 2022. The future arising activities have been determined using information from in-stock data and predictive modelling.

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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:

Activity is determined by a variety of analytical techniques that include radiochemical analysis, high and low resolution gamma-ray spectroscopy, passive neutron coincidence counting and liquid scintillation counting.

Other information:

Decay nuclides with a half-life of less than 3 months have been omitted.

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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			1.2E-04	CC 2	Gd 153				
Be 10					Ho 163				
C 14				5	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				5
Mn 54					Pb 205				
Fe 55			2.83E-05	CC 2	Pb 210				5
Co 60	1.15E-03	BB 2	3.27E-04	CC 2	Bi 208				
Ni 59				5	Bi 210m				
Ni 63			1.81E-04	CC 2	Po 210				5
Zn 65					Ra 223				5
Se 79					Ra 225				5
Kr 81					Ra 226				5
Kr 85					Ra 228				5
Rb 87					Ac 227				5
Sr 90				5	Th 227				5
Zr 93					Th 228				5
Nb 91					Th 229				5
Nb 92					Th 230				5
Nb 93m					Th 232				5
Nb 94	2.52E-08	BB 2		5	Th 234				5
Mo 93					Pa 231				5
Tc 97					Pa 233				5
Tc 99					U 232		7.28E-11	CC 2	
Ru 106				5	U 233				
Pd 107					U 234				5
Ag 108m	7.81E-09	BB 2			U 235				5
Ag 110m				5	U 236				5
Cd 109					U 238				5
Cd 113m					Np 237				5
Sn 119m					Pu 236				
Sn 121m					Pu 238				5
Sn 123					Pu 239		1.23E-07	CC 2	
Sn 126					Pu 240				5
Sb 125					Pu 241				5
Sb 126					Pu 242		1.05E-10	CC 2	
Te 125m					Am 241		5.41E-09	CC 2	
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137	1.34E-07	BB 2	3.53E-05	CC 2	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144				5	Cf 249				
Pm 145					Cf 250				
Pm 147				5	Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					Total a	0	1.29E-07	CC 2	
Eu 155					Total b/g	1.15E-03	BB 2	6.92E-04	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