

WASTE STREAM 7A112 Decommissioning LLW - Natural / Depleted Uranium**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.....	19.7 m ³
Future arisings -	1.4.2022 - 31.3.2024.....	8.0 m ³
	1.4.2025 - 31.3.2030.....	0 m ³
	1.4.2031 - 31.3.2033.....	202.0 m ³
	1.4.2034 - 31.3.2036.....	324.0 m ³
	1.4.2037 - 31.3.2039.....	160.0 m ³
	1.4.2040 - 31.3.2042.....	52.0 m ³
	1.4.2043 - 31.3.2080.....	0 m ³
Total future arisings:		746.0 m ³
Total waste volume:		765.7 m ³

Comment on volumes: Future arisings are estimated on recently reviewed decommissioning plans for facilities on site. The total volume of waste arisings will depend on the longevity of the AWE site with estimates being based on a 2080 site closure date. The stock volume is accurate and taken straight from AWE's Solid Radioactive Waste Management Records System (SRWMRS) electronic database. Future volumes and uncertainties are based upon the content of the current AWE Annual Review of Nuclear Liabilities and the supporting databases.

Uncertainty factors on volumes: Stock (upper): x 1.0 Arisings (upper) x 5.0
Stock (lower): x 1.0 Arisings (lower) x 0.2

WASTE SOURCE Waste arising from depleted and natural uranium decommissioning operations.**PHYSICAL CHARACTERISTICS**

General description: The 7A112 Waste Stream contains metals (43.74%), rubble (43.16%), cellulosic material (6.28%), NH plastic/plastic/rubber (6.73%), asbestos (0.07%) and graphite (0.02%).

Physical components (%wt): The 7A112 Waste Stream contains metals (43.74%), rubble (43.16%), cellulosic material (6.28%), NH plastic/plastic/rubber (6.73%), asbestos (0.07%) and graphite (0.02%). The physical components have been reviewed in 2022 and are based upon latest 7A112 disposal information, as stock data is exceedingly sparse.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.51

Comment on density: The density has been calculated using 7A112 disposal data, as in-stock data is extremely sparse.

CHEMICAL COMPOSITION

General description and components (%wt): The 7A112 Waste Stream contains metals (43.74%), rubble (43.16%), cellulosic material (6.28%), NH plastic/plastic/rubber (6.73%), asbestos (0.07%) and graphite (0.02%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Not present in this waste stream
C-14: Not present in this waste stream
Cl-36: Not present in this waste stream
Se-79: Not present in this waste stream
Tc-99: Not present in this waste stream
I-129: Not present in this waste stream
Ra: Only daughter products present from uranium in this waste stream. Oxide form.
Th: Only daughter products present from uranium in this waste stream. Oxide form.
U: Present in this waste stream. Oxide form.
Np: Not present in this waste stream
Pu: Not present in this waste stream

Metals and alloys (%wt): The majority of the decommissioning metal is sheets and pipes that are typically 4mm in

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thickness.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	43.5		
Iron.....	0		
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....	0		
Titanium.....	0		
Uranium.....	0		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	0.23	Tin, brass and copper (unknown % weights)	

Organics (%wt):

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	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	6.3		
Paper, cotton.....	0.21		
Wood.....	6.1		
Halogenated plastics	4.6		
Total non-halogenated plastics.....	1.9		
Condensation polymers.....	1.9		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0.27		
Halogenated rubber	0.27		
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.....	43.2		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0.02		
Desiccants/Catalysts.....	0		
Asbestos.....	0.07	Asbestos is likely to be moderately / highly friable	
Non/low friable.....	NE		
Moderately friable.....	NE		
Highly friable.....	NE		
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: This waste stream contains asbestos.

	(%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.....	P	
Putrescible wastes.....	0	
Non-putrescible wastes.....	P	Paper, cotton and wood present in the waste

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stream

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: This waste stream contains asbestos.

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	0	
Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	
Phenol.....	0	
Styrene.....	0	
Tri-butyl phosphate.....	0	
Other organophosphates.....	0	
Vinyl chloride.....	P	PVC is present in the waste stream
Arsenic.....	0	
Barium.....	0	
Boron.....	0	
Boron (in Boral).....	0	
Boron (non-Boral).....	0	
Cadmium.....	0	
Caesium.....	0	
Selenium.....	0	
Chromium.....	0	
Molybdenum.....	0	
Thallium.....	0	
Tin.....	0	
Vanadium.....	0	
Mercury compounds.....	0	
Others.....	0	
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): No

	(%wt)	Type(s) and comment
EDTA.....	0	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids.....	0	
Other organic complexants.....	0	
Total complexing agents.....	0	

Potential for the waste to contain discrete items: Not yet determined.

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 Off-site	 ~56.0

Comment on planned treatments: No change since the 2019 UKRWI.

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	~56.0	<0.51
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	~44.0	>0.51
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):

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			

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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: (Not applicable to this waste stream)

Container	Stream volume %	Waste loading m ³	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: No waste in this waste stream is envisaged to go to the repository at LLWR.

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: U-234, U-235, U-236 and U-238 contaminated waste (specifically depleted and natural uranium).

Uncertainty: The gross alpha and gross beta activities of the in-stock wastes are accurate. The in-stock radionuclide breakdown is also accurate, as this has also been acquired from the AWE Solid Radioactive Waste Management Records System (SRWMRS) electronic database. The future arisings specific activities have been taken from the latest 7A112 disposal data, whilst the radionuclide breakdown has been calculated through the generation of a 'weighted mean' fingerprint associated to facilities that produce waste stream 7A112.

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 fingerprints for these wastes are determined by the materials that have contaminated them, which are used in conjunction with high resolution gamma spectrometry to assay the wastes.

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					Gd 153				
Be 10					Ho 163				
C 14					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				
Mn 54					Pb 205				
Fe 55					Pb 210	5.99E-13	BB 2	2.26E-14	CC 2
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	5.99E-13	BB 2	2.15E-14	CC 2
Zn 65					Ra 223	6.23E-12	BB 2	2.67E-13	CC 2
Se 79					Ra 225				
Kr 81					Ra 226	1.64E-12	BB 2	6.27E-14	CC 2
Kr 85					Ra 228	3.08E-14	BB 2	9.30E-20	CC 2
Rb 87					Ac 227	6.25E-12	BB 2	2.68E-13	CC 2
Sr 90					Th 227	6.15E-12	BB 2	2.64E-13	CC 2
Zr 93					Th 228	2.89E-18	BB 2	8.65E-20	CC 2
Nb 91					Th 229				
Nb 92					Th 230	1.47E-10	BB 2	6.07E-12	CC 2
Nb 93m					Th 232	3.67E-18	BB 2	1.12E-19	CC 2
Nb 94					Th 234	2.38E-07	BB 2	2.43E-08	CC 2
Mo 93					Pa 231	1.22E-11	BB 2	5.5E-13	CC 2
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234	3.07E-07	BB 2	1.38E-08	CC 2
Ag 108m					U 235	1.11E-08	BB 2	5.41E-10	CC 2
Ag 110m					U 236	1.43E-09	BB 2	4.75E-11	CC 2
Cd 109					U 238	2.38E-07	BB 2	2.43E-08	CC 2
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137					Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					Total a	5.58E-07	BB 2	3.86E-08	CC 2
Eu 155					Total b/g	2.38E-07	BB 2	2.43E-08	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