

WASTE STREAM	7A26	Operational LLW - Enriched Uranium
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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.....	61.8 m ³
Future arisings -	1.4.2022 - 31.3.2024.....	30.0 m ³
	1.4.2025 - 31.3.2027.....	40.0 m ³
	1.4.2028 - 31.3.2030.....	37.0 m ³
	1.4.2031 - 31.3.2033.....	28.0 m ³
	1.4.2034 - 31.3.2036.....	9.0 m ³
	1.4.2037 - 31.3.2039.....	13.0 m ³
	1.4.2040 - 31.3.2042.....	10.0 m ³
	1.4.2043 - 31.3.2045.....	10.0 m ³
	1.4.2046 - 31.3.2048.....	21.0 m ³
	1.4.2049 - 31.3.2051.....	10.0 m ³
	1.4.2052 - 31.3.2054.....	10.0 m ³
	1.4.2055 - 31.3.2057.....	10.0 m ³
	1.4.2058 - 31.3.2060.....	40.0 m ³
	1.4.2061 - 31.3.2063.....	24.0 m ³
	1.4.2064 - 31.3.2066.....	3.0 m ³
	1.4.2067 - 31.3.2069.....	3.0 m ³
	1.4.2070 - 31.3.2071.....	12.0 m ³
1.4.2072 - 31.3.2080.....	0 m ³	
Total future arisings:		310.0 m ³
Total waste volume:		371.8 m ³

Comment on volumes: The stock volume has slightly increased since the last inventory, which is partly attributable to the site filter exchange programme. The waste arisings are based on facility estimates in the AWE Decommissioning Liabilities Plan. Stock volumes are recorded on the site waste database (SRWMRS) and therefore, 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 3.0
	Stock (lower):	x 1.0	Arisings (lower)	x 0.3

WASTE SOURCE Waste arisings from enriched uranium operations.

PHYSICAL CHARACTERISTICS

General description: The waste contains metal, plastics, rubber, glass, fibre-glass, asbestos and vermiculite.

Physical components (%wt): Metal (46.72%), non-halogenated plastics (32.69%), halogenated plastics (1.39%), rubber (3.26%), glass (10.87%), fibre-glass (1.56%), asbestos (3.44%) and vermiculite (0.07%). The composition is based on the 2019 UKRWI submission as the 2022 stock density is practically identical to the 2019 UKRWI density figure.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.38

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): Metal (46.72%), non-halogenated plastics (32.69%), halogenated plastics (1.39%), rubber (3.26%), glass (10.87%), fibre-glass (1.56%), asbestos (3.44%) and vermiculite (0.07%).

WASTE STREAM	7A26	Operational LLW - Enriched Uranium
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Chemical state: Neutral

Chemical form of radionuclides: H-3: Not present in Waste Stream
 C-14: Not present in Waste Stream
 Cl-36: Not present in Waste Stream
 Se-79: Not present in Waste Stream
 Tc-99: Not present in Waste Stream
 I-129: Not present in 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 Waste Stream as oxide form
 Np: Not present in Waste Stream
 Pu: Not present in Waste Stream

Metals and alloys (%wt): Steel in the form of box fittings, tools and fixtures. Lead is present in the form of shielding panels. As this is an operational waste stream, metal is likely to arise as mixed metal (ferrous and non-ferrous segregated) in drums.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	2.9		
Other ferrous metals.....	33.3		
Iron.....	0		
Aluminium.....	2.1		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	3.5		
Lead.....	3.3		
Magnox/Magnesium.....	0		
Nickel.....	0		
Titanium.....	0		
Uranium.....	NE	Present as a contaminant only	
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	1.6	Tin	

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics	1.4	PVC	
Total non-halogenated plastics.....	32.7		
Condensation polymers.....	28.2		
Others.....	4.5	Perspex	
Organic ion exchange materials....	0		
Total rubber.....	3.3		
Halogenated rubber	0		
Non-halogenated rubber.....	3.3		
Hydrocarbons.....	0		
Oil or grease	0		
Fuel.....	0		

WASTE STREAM	7A26	Operational LLW - Enriched Uranium
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Asphalt/Tarmac (cont.coal tar)...	0
Asphalt/Tarmac (no coal tar).....	0
Bitumen.....	0
Others.....	0
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.....	0.07	Vermiculite	
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	12.4	Glass (10.87% wt) and fibreglass (1.56% wt)	
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	3.4		
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.....	0.06	
Nitrite.....	0.06	
Phosphate.....	0.02	
Sulphate.....	0	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: This waste stream contains asbestos and lead.

WASTE STREAM

7A26

Operational LLW - Enriched Uranium

	(%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	
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: This waste stream contains asbestos and lead.

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	NE	
Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	
Phenol.....	NE	
Styrene.....	0	
Tri-butyl phosphate.....	NE	
Other organophosphates.....	0	
Vinyl chloride.....	P	PVC
Arsenic.....	NE	
Barium.....	NE	
Boron.....	NE	
Boron (in Boral).....	NE	
Boron (non-Boral).....	0	
Cadmium.....	NE	
Caesium.....	0	
Selenium.....	NE	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....	NE	
Tin.....	NE	

WASTE STREAM 7A26 Operational LLW - Enriched Uranium

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

Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....	0	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids.....	0	
Other organic complexants.....	0	The waste stream does not contain any organic complexing agents.
Total complexing agents.....	0	

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	~5.0
Incineration	Off-site	~1.0
Solidification		
Decontamination		
Metal treatment	Off-site	~42.0
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None	Off-site	~52.0

Comment on planned treatments:

Treatment % are estimated based on disposals made over the past 6 years and are likely to fluctuate.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~5.0	~0.38
Expected to be consigned to a Landfill Facility	~52.0	~0.38
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	~1.0	~0.38
Expected to be consigned to a Metal Treatment Facility	~42.0	~0.38
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: 170601, 160305, 170409, 150202, 200140, 203001

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: 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			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO			
1/2 Height IP-2 Disposal/Re-usable ISO	5.0	17	2
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: Voidage will be minimal as the waste will be supercompacted prior to LLWR disposal (assuming that the fissile quantities within each package are acceptable to the supercompaction service producer's WAC).

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

Waste consigned for disposal to LLWR in year of generation: Yes.

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 (enriched) contaminated material.

Uncertainty: The gross alpha and gross beta/gamma activities for the in-stock waste are accurate. The

WASTE STREAM**7A26****Operational LLW - Enriched Uranium**

Definition of total alpha and total beta/gamma:	radionuclide fingerprint has been calculated from facility arisings. Predicted waste activities are based upon in-stock arisings, as they are very similar to those collated during the 2019 UKRWI. 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:	This waste stream is generally assayed using either low or high resolution gamma-ray spectroscopy. Mass balance is used occasionally where considered to be the BAT assay method.
Other information:	-

WASTE STREAM

7A26

Operational LLW - Enriched Uranium

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	4.88E-15	BB 2	2.86E-15	CC 2
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	2.98E-15	BB 2	1.75E-15	CC 2
Zn 65					Ra 223	8.08E-13	BB 2	5.12E-13	CC 2
Se 79					Ra 225				
Kr 81					Ra 226	1.63E-13	BB 2	9.55E-14	CC 2
Kr 85					Ra 228	9.2E-19	BB 2	4.82E-19	CC 2
Rb 87					Ac 227	8.74E-13	BB 2	5.53E-13	CC 2
Sr 90					Th 227	8.21E-13	BB 2	5.20E-13	CC 2
Zr 93					Th 228	2.65E-19	BB 2	1.39E-19	CC 2
Nb 91					Th 229				
Nb 92					Th 230	2.51E-10	BB 2	1.47E-10	CC 2
Nb 93m					Th 232	5.74E-18	BB 2	3.00E-18	CC 2
Nb 94					Th 234	2.49E-07	BB 2	4.15E-06	CC 2
Mo 93					Pa 231	1.89E-11	BB 2	1.20E-11	CC 2
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234	9.11E-06	BB 2	5.33E-06	CC 2
Ag 108m					U 235	2.96E-07	BB 2	1.88E-07	CC 2
Ag 110m					U 236	3.88E-08	BB 2	2.03E-08	CC 2
Cd 109					U 238	2.49E-07	BB 2	4.15E-06	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	9.69E-06	BB 2	9.69E-06	CC 2
Eu 155					Total b/g	2.49E-07	BB 2	4.15E-06	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