WASTE STREAM 7A24 Operational LLW - Depleted/Natural 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.....	90.0 m³
Future arisings -	1.4.2022 - 31.3.2024.....	63.0 m³
	1.4.2025 - 31.3.2027.....	86.0 m³
	1.4.2028 - 31.3.2030.....	24.0 m³
	1.4.2031 - 31.3.2033.....	10.0 m³
	1.4.2033 - 31.3.2080.....	0 m³
Total future arisings:		183.0 m³
Total waste volume:		273.0 m³

Comment on volumes: The stock volume has decreased since the 2019 UKRWI owing to regular disposals. The arising rate has been reviewed and revised with a slight increase in future arisings and is based upon the AWE site liabilities plan. Stock volumes are recorded on the site waste database (SRWMRS) and are considered to be accurate. The total volume of arisings will be 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 for natural and depleted uranium operations.

PHYSICAL CHARACTERISTICS

General description: The waste stream contains metal, cellulosic material, plastics, rubber, leather, soil, rubble, sand, glass, fibreglass and graphite.

Physical components (%wt): The waste stream contains metal (26.26%), cellulosic material (26.04%), plastics (11.29%), rubber (0.09%), leather (0.16%), soil (0.80%), rubble (9.97%), sand (21.31%), glass (2.99%), fibreglass (0.23%) and graphite (0.86%). The composition has been reviewed and revised during the 2022 UKRWI using disposal data from between 2019 and 2022.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.55

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 stream contains metal (26.26%), cellulosic material (26.04%), plastics (11.29%), rubber (0.09%), leather (0.16%), soil (0.80%), rubble (9.97%), sand (21.31%), glass (2.99%), fibreglass (0.23%) and graphite (0.86%).

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): The majority of the metallic waste in this waste stream arises as mixed metal, which is

segregated into ferrous and non-ferrous wherever practicable. The principal containers used are 205 litre drums and Pactec bags.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	10.2		
Other ferrous metals	3.9		
Iron	0		
Aluminium	8.9		
Beryllium	<0.01		
Cobalt	0		
Copper	0.50		
Lead	2.7		
Magnox/Magnesium	0		
Nickel	0		
Titanium	0		
Uranium	0		
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	0		

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	26.0		
Paper, cotton	9.0		
Wood	17.0		
Halogenated plastics	3.5	PVC	
Total non-halogenated plastics	7.8		
Condensation polymers	7.8		
Others	0		
Organic ion exchange materials	0		
Total rubber	0.09		
Halogenated rubber	0.09		
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	0.16	Leather	

Other materials (%wt): -

WASTE STREAM 7A24 Operational LLW - Depleted/Natural Uranium

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0.80		
Brick/Stone/Rubble.....	10.0	Hoover bag contents	
Cementitious material.....			
Sand.....	21.3	Sand (5.87%) and absorption media (15.44%)	
Glass/Ceramics.....	3.2	Glass (2.99%) and fibreglass (0.23%)	
Graphite.....	0.86		
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): Calcium silicate is present (~15.44% 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: Lead is present in the waste stream.

	(%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	

WASTE STREAM 7A24 Operational LLW - Depleted/Natural Uranium

Non-putrescible wastes.....	P	Paper, cotton and wood are present
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: Lead is present in the waste stream.

	(%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
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	

WASTE STREAM 7A24 Operational LLW - Depleted/Natural Uranium

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	Off-site	~15.0
Supercompaction (HFC)	Off-site	~15.0
Incineration	Off-site	~2.0
Solidification		
Decontamination		
Metal treatment	Off-site	~26.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		~42.0

Comment on planned treatments: Off-site treatment percentage estimated from disposals between 2016 and 2022. Supercompaction for waste destined to the LLWR for burial. Low force compaction is for waste destined for LA-LLW Permitted Landfill.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~15.0	~0.55
Expected to be consigned to a Landfill Facility	~57.0	~0.55
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	~2.0	~0.55
Expected to be consigned to a Metal Treatment Facility	~26.0	~0.55
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: 160305, 170106, 170410, 150202, 150203, 200140, 200301

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			

WASTE STREAM 7A24 Operational LLW - Depleted/Natural Uranium

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 m³	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	~15.0	~17	3

Other information: ~15% goes directly to LLWR via supercompaction.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Supercompacted pucks, so voidage is minimal.

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: Operations involving materials contaminated with depleted uranium. Operations involving natural uranium are less abundant.

Uncertainty: The gross alpha and gross beta/gamma activity is accurate and taken from stock. Radionuclide values are based on disposal and stock data, which are reasonably accurate.

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: This waste stream is principally assayed using high resolution gamma-ray spectroscopy and characterised using robust fingerprints.

Other information: Radionuclides with a half-life of <3 months have been omitted.

WASTE STREAM 7A24 Operational LLW - Depleted/Natural Uranium

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ 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				
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234	5.2E-06	B B 2	1.04E-05	C C 2
Ag 108m					U 235	2.05E-07	B B 2	3.11E-07	C C 2
Ag 110m					U 236	1.8E-08	B B 2	3.58E-08	C C 2
Cd 109					U 238	9.33E-06	B B 2	1.87E-05	C C 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**	**1.48E-05**	**B B 2**	**2.94E-05**	**C C 2**
Eu 155					**Total b/g**	**0**		**0**	

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