

WASTE STREAM**7A24****Operational LLW - Depleted/Natural Uranium****SITE** AWE Aldermaston**SITE OWNER** Ministry of Defence**WASTE CUSTODIAN** AWE plc**WASTE TYPE** LLW**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	116.4 m ³
Future arisings -	1.4.2019 - 31.3.2022.....	103.6 m ³
	1.4.2022 - 31.3.2025.....	52.7 m ³
	1.4.2025 - 31.3.2028.....	5.0 m ³
	1.4.2028 - 31.3.2031.....	13.9 m ³
	1.4.2031 - 31.3.2080.....	0 m ³
Total future arisings:		175.2 m ³
Total waste volume:		291.6 m ³

Comment on volumes: The stock volume has decreased since the last inventory, this is due to disposals. The arising rate has been re-estimated based on current processes within existing DU/NU producing facilities. Stock volumes are recorded in a recently issued database, and are therefore considered to be accurate. The total volume of arisings will depend on the longevity of the AWE site, estimates have been made based on a site closure date of 2080.

Uncertainty factors on volumes: Stock (upper): x 1.0 Arisings (upper) x 2.0
 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 contains metal, cellulose, plastics/rubber, rubble, concrete, cement & sand, graphite and vermiculite.

Physical components (%wt): Metal (60.75%), plastics (11.0%), paper (3.47%), cotton (2.5%), wood (8.6%), rubble (6.88%), absorption material (5.1%), asbestos (0.9%) and rubber (0.8%). The composition has barely changed over the past 3 years, so has been kept consistent to the 2016 RWI data.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.51

Comment on density: Revised for the 2019 UK RWI, based on the in-stock wastes, and consistent with the 2016 RWI figure.

CHEMICAL COMPOSITION

General description and components (%wt): Metal (60.75%), plastics (11.0%), paper (3.47%), cotton (2.5%), wood (8.6%), rubble (6.88%), absorption material (5.1%), asbestos (0.9%) and rubber (0.8%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: HTO and HT forms.
 U: Oxide form.
 Pu: Oxide form.

Metals and alloys (%wt): The majority of the metallic waste in this stream arises as mixed metal (segregated into ferrous and non-ferrous) in drums. Some arises as sheet metal, tanks, stacks or large machine tools, metal thickness varies.

Stainless steel.....	2.3
Other ferrous metals.....	52.4
Iron.....	
Aluminium.....	4.3
Beryllium.....	<0.01
Cobalt.....	
Copper.....	0.90

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	Lead.....	0.90	
	Magnox/Magnesium.....		
	Nickel.....		
	Titanium.....		
	Uranium.....	NE	Present as a contaminant only
	Zinc.....		
	Zircaloy/Zirconium.....		
	Other metals.....		Filters
Organics (%wt):	PVC.		
	Total cellulosics.....	14.6	
	Paper, cotton.....	6.0	
	Wood.....	8.6	
	Halogenated plastics	4.4	PVC
	Total non-halogenated plastics.....	6.5	
	Condensation polymers.....	6.5	
	Others.....		
	Organic ion exchange materials....		
	Total rubber.....	0.80	
	Halogenated rubber		
	Non-halogenated rubber.....		
	Hydrocarbons.....		
	Oil or grease		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	<0.10	
Other materials (%wt):	Rubble includes bricks and concrete.		
	Inorganic ion exchange materials.		
	Inorganic sludges and flocs.....		
	Soil.....		
	Brick/Stone/Rubble.....	6.9	Vermiculite
	Cementitious material.....		
	Sand.....	4.5	Absorption media (normally vermiculite)
	Glass/Ceramics.....	0.50	
	Graphite.....	0.10	
	Desiccants/Catalysts.....		
	Asbestos.....	0.90	
	Non/low friable.....	0.90	
	Moderately friable.....		
	Highly friable.....		

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	Free aqueous liquids.....	
	Free non-aqueous liquids.....	
	Powder/Ash.....	
Inorganic anions (%wt):	Calcium silicate is present (3%wt).	
	Fluoride.....	
	Chloride.....	<0.01
	Iodide.....	
	Cyanide.....	
	Carbonate.....	
	Nitrate.....	<0.20
	Nitrite.....	
	Phosphate.....	<0.20
	Sulphate.....	<0.10
	Sulphide.....	<0.01

Materials of interest for waste acceptance criteria:

	-	
	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
	Corrosive materials.....	P
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	0
	Active particles.....	0
	Soluble solids as bulk chemical compounds.....	0

Paper, cotton and wood are present.
<0.04%

Hazardous substances / non hazardous pollutants:

	This waste contains lead and beryllium.	
	Acrylamide.....	0
	Benzene.....	0
	Chlorinated solvents.....	0
	Formaldehyde.....	0
	Organometallics.....	0
	Phenol.....	0
	Styrene.....	0
	Tri-butyl phosphate.....	0
	Other organophosphates.....	0

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Vinyl chloride.....	P	PVC
Arsenic.....	0	
Barium.....	0	
Boron.....	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.....		
EEE Type 2.....		
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		
Complexing agents (%wt):	No	
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....		

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	~15.0
Supercompaction (HFC)	Off-site	~15.0
Incineration	Off-site	~2.0
Solidification		
Decontamination		
Metal treatment	Off-site	~27.0
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		~41.0

Comment on planned treatments:

Off-site treatment % estimated from disposals between 2016 -2019 are very similar to the 2013-2016 data, hence unchanged. Low force compaction waste has been added to waste with no treatment indicating that there is no further treatment.

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Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	~16.0
Expected to be consigned to a Landfill Facility	~55.0
Expected to be consigned to an On-Site Disposal Facility	
Expected to be consigned to an Incineration Facility	~2.0
Expected to be consigned to a Metal Treatment Facility	~27.0
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 ³	Number of packages
1/3 Height IP-1 ISO			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO	~16.0	~17	3
1/2 Height IP-2 Disposal/Re-usable ISO			
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: 15% goes indirectly 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.

Potential for the waste to contain discrete items: No, waste going to the LLWR will be supercompacted pucks

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

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Source:	Depleted and natural uranium contamination.
Uncertainty:	The gross alpha and gross beta / gamma activity is accurate, radionuclide values have been estimated from disposal data.
Definition of total alpha and total beta/gamma:	Radionuclides with a half life of < 3 months have been omitted.
Measurement of radioactivities:	Typically these wastes would have been assayed using HRGS
Other information:	-

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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			4.04E-08	C C 2	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	2.83E-06	BB 2	5.67E-06	CC 2
Ag 108m					U 235	1.11E-07	BB 2	2.23E-07	CC 2
Ag 110m					U 236	9.81E-09	BB 2	1.95E-09	CC 2
Cd 109					U 238	5.08E-06	BB 2	1.02E-05	CC 2
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238	4.09E-09	BB 2	3.27E-09	CC 2
Sn 123					Pu 239	6.38E-08	BB 2	7.48E-08	CC 2
Sn 126					Pu 240	1.49E-08	BB 2	1.98E-08	CC 2
Sb 125					Pu 241	1.06E-05	BB 2	1.29E-07	CC 2
Sb 126					Pu 242	1.73E-13	BB 2	3.09E-12	CC 2
Te 125m					Am 241	1.86E-07	BB 2	4.03E-08	CC 2
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	8.30E-06	BB 2	1.62E-05	CC 2
Eu 155					Total b/g	1.06E-05	BB 2	1.70E-07	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