WASTE STREAM 7A27 Operational LLW - Plutonium

SITE AWE Aldermaston

SITE OWNER Ministry of Defence

WASTE CUSTODIAN AWE plc

WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	305.6 m³
Future arisings -	1.4.2019 - 31.3.2022.....	114.0 m³
	1.4.2022 - 31.3.2025.....	80.0 m³
	1.4.2025 - 31.3.2028.....	97.0 m³
	1.4.2028 - 31.3.2031.....	128.0 m³
	1.4.2031 - 31.3.2056.....	575.0 m³
	1.4.2056 - 31.3.2062.....	140.0 m³
	1.4.2062 - 31.3.2080.....	0 m³
Total future arisings:		1134.0 m³
Total waste volume:		1439.6 m³

Comment on volumes: The stock has increased by 145.1 m3 due to predicted recategorization of stock from waste stream 7A23. Arising rates are based on typical facility arisings from the AWE waste arisings prediction plan. Stock volumes are 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 5.0
Stock (lower):	x 1.0	Arisings (lower)	x 0.2

WASTE SOURCE Waste arising from plutonium operations.

PHYSICAL CHARACTERISTICS

General description: The waste contains plastics, cellulosics and metals. Encapsulated oils and sludges are no longer specified as part of this waste stream.

Physical components (%wt): Metal - 59.66%, Cellulosics - 9.16%, plastics - 23.04%, rubber - 2.85% and other - 4.85%.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.56

Comment on density: Calculated from 2019 in-stock wastes.

CHEMICAL COMPOSITION

General description and components (%wt): Metal - 59.66%, Celluosics - 9.16%, plastics - 23.04%, rubber - 2.85% and other - 4.85%. Reviewed for the 2019 RWI from data from recent disposals.

Chemical state: Neutral

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

Metals and alloys (%wt): This is an operational waste, typically the metal produced is drums of mixed metal waste (ferrous and non-ferrous segregated). Occassional thin panels are produced.

Stainless steel.....	7.6
Other ferrous metals.....	34.4
Iron.....	
Aluminium.....	2.8
Beryllium.....	<0.05
Cobalt.....	
Copper.....	0.86
Lead.....	0.19
Magnox/Magnesium.....	

WASTE STREAM	7A27	Operational LLW - Plutonium	
	Nickel		
	Titanium		
	Uranium		
	Zinc		
	Zircaloy/Zirconium		
	Other metals	13.7	Includes filters and WEEE.
Organics (%wt):	PVC.		
	Total cellulosics	9.2	
	Paper, cotton	5.4	Includes hoover bags + contents.
	Wood	3.7	
	Halogenated plastics	16.9	PVC.
	Total non-halogenated plastics	6.1	
	Condensation polymers	3.8	
	Others	2.3	
	Organic ion exchange materials		
	Total rubber	2.9	
	Halogenated rubber		
	Non-halogenated rubber	2.9	
	Hydrocarbons		
	Oil or grease		
	Fuel		
	Asphalt/Tarmac (cont.coal tar)		
	Asphalt/Tarmac (no coal tar)		
	Bitumen		
	Others		
	Other organics		
Other materials (%wt):	-		
	Inorganic ion exchange materials.		
	Inorganic sludges and flocs		
	Soil		
	Brick/Stone/Rubble	4.6	
	Cementitious material		
	Sand	0.05	
	Glass/Ceramics	0.35	
	Graphite	0.21	
	Desiccants/Catalysts		
	Asbestos	<0.10	
	Non/low friable		
	Moderately friable		
	Highly friable		
	Free aqueous liquids		
	Free non-aqueous liquids		

WASTE STREAM 7A27 Operational LLW - Plutonium

	Powder/Ash.....		
Inorganic anions (%wt):	-		
	Fluoride.....		
	Chloride.....	<0.70	
	Iodide.....		
	Cyanide.....		
	Carbonate.....	<0.50	
	Nitrate.....	<0.50	
	Nitrite.....		
	Phosphate.....	<0.50	
	Sulphate.....	<0.70	
	Sulphide.....		
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	Wood, paper and cotton.
	Corrosive materials.....	0	
	Pyrophoric materials.....	0	
	Generating toxic gases.....	0	
	Reacting with water.....	0	
	Active particles.....	0	
	Soluble solids as bulk chemical compounds.....	0	
Hazardous substances / non hazardous pollutants:	Asbestos (<0.1%wt).		
	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.....	NE	

WASTE STREAM 7A27 Operational LLW - Plutonium

Barium..... 0

Boron..... NE

Cadmium..... NE

Caesium..... 0

Selenium..... NE

Chromium..... NE

Molybdenum..... NE

Thallium..... 0

Tin..... NE

Vanadium..... NE

Mercury compounds..... 0

Others..... NE

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.....

The waste contains no inorganic complexing agents.

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	~10.0
Incineration	Off-site	~1.0
Solidification		
Decontamination		
Metal treatment	Off-site	~8.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		~81.0

Comment on planned treatments: Treatment % are estimated based on disposals made over the past 3 years and are likely to fluctuate. Currently very little treatable metal is being generated in this stream.

WASTE STREAM 7A27 Operational LLW - Plutonium

Disposal Routes:

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	~5.0
Expected to be consigned to a Landfill Facility	~86.0
Expected to be consigned to an On-Site Disposal Facility	
Expected to be consigned to an Incineration Facility	~1.0
Expected to be consigned to a Metal Treatment Facility	~8.0
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 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	5.0	~17	5
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: Wastes destined to LLWR are likely to go via supercompaction.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Voidage will be minimal as wastes will be supercompacted prior to LLWR disposal.

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, wastes entering the LLWR will have been supercompacted.

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

WASTE STREAM 7A27 Operational LLW - Plutonium

Source:	Plutonium, uranium and americium contaminated material.
Uncertainty:	The gross alpha and gross beta / gamma activities for the in-stock wastes are accurate, radionuclide breakdown has been estimated. Predicted waste activities are based on disposals made in the last 3 years.
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:	Typically this waste is measured using HRGS.
Other information:	-

WASTE STREAM 7A27 Operational LLW - Plutonium

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3		6	1.60E-09	C C 2	Gd 153				
Be 10		6			Ho 163				
C 14		6			Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36		6			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		6		6	Pb 210				
Co 60	1.16E-09	C C 2	1.07E-11	C C 2	Bi 208				
Ni 59					Bi 210m				
Ni 63		6		6	Po 210				
Zn 65		6			Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226		6		
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90		6			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		6			U 232	5.43E-10	C C 2		
Ru 106		6			U 233				
Pd 107					U 234	5.96E-05	C C	1.65E-06	C C
Ag 108m					U 235	1.95E-06	C C	5.51E-08	C C
Ag 110m		6			U 236	3.01E-07	C C	4.28E-09	C C
Cd 109					U 238	5.60E-06	C C	1.32E-06	C C
Cd 113m					Np 237		6		
Sn 119m					Pu 236		6		
Sn 121m					Pu 238	1.23E-05	B B	1.64E-07	C C
Sn 123					Pu 239	3.82E-04	B B	5.22E-06	C C
Sn 126					Pu 240	9.07E-05	B B	1.16E-06	C C
Sb 125		6			Pu 241	2.18E-04	B B	4.60E-06	C C
Sb 126					Pu 242	9.97E-09	B B	1.37E-10	C C
Te 125m					Am 241	1.12E-04	B B	6.93E-07	C C
Te 127m					Am 242m				
I 129		6			Am 243				
Cs 134		6			Cm 242				
Cs 135					Cm 243				
Cs 137	5.45E-08	C C 2			Cm 244				
Ba 133		6			Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144		6			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**	**6.65E-04**	**B B 2**	**1.03E-05**	**C C 2**
Eu 155					**Total b/g**	**2.19E-04**	**B B 2**	**4.61E-06**	**C C 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