WASTE STREAM 7A32 Sealed and Unsealed Sources

SITE	AWE Aldermaston
SITE OWNER	Ministry of Defence
WASTE CUSTODIAN	AWE plc
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m^3
Future arisings -	1.4.2022 - 31.3.2080.....	87.0 m^3
Total future arisings:		87.0 m^3
Total waste volume:		87.0 m^3

Comment on volumes: AWE ceased cementation of redundant sources back in 2005 and now transports sources to a treatment/transfer facility (via an expert contract partner), as the current BAT option. Future arising volumes are based on 2018-2021 disposal volumes projected until 2080, i.e. 1.5 m3 per year. This new prediction figure is similar to that predicted in the 2013, 2016 and 2019 UKRWI exercises. Stock volumes are recorded in a recently issued database and are considered 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	Arisings (upper)	x 10.0
Stock (lower):	x	Arisings (lower)	x 0.1

WASTE SOURCE This waste stream comprises of miscellaneous ILW redundant sources that have been used for calibration of radiological equipment, assay/characterisation processes, and experiments and research.

PHYSICAL CHARACTERISTICS

General description:	The redundant sources contain solids and/or liquids with no gas inners.
Physical components (%wt):	(Metal (63.08%), Plastic (31.43%) & Glass (5.49%)
Sealed sources:	The waste contains sealed sources. The waste contains sealed sources. There are 100% sealed and unsealed sources per waste stream.
Bulk density (t/m^3):	0.278
Comment on density:	The density was reviewed for the 2022 UKRWI and is based upon the last 6 years disposals.

CHEMICAL COMPOSITION

General description and components (%wt):	Other ferrous metals (30.36%), alumium (14.65%), copper (1.40%), uranium (16.67%), non-halogenated plastics (25.33%), PVC (6.10%), glass (5.49%).
Chemical state:	Neutral
Chemical form of radionuclides:	H-3: Present in the waste stream in oxide / chloride form C-14: Present in the waste stream in oxide / chloride / sulphate form Cl-36: May be present in waste stream in compound form, depending upon future demand Se-79: May be present in waste stream in compound form, depending upon future demand Tc-99: Not present in the waste stream I-129: Not present in the waste stream Ra: Present in the waste stream in oxide / chloride / sulphate form Th: Present in the waste stream in oxide / chloride / sulphate form U: Present in waste stream as metal and metal oxide / metal chloride / metal sulphate Np: Present in the waste stream in oxide / chloride / sulphate form Pu: Present in the waste stream in oxide / chloride / sulphate form
Metals and alloys (%wt):	Not applicable.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	30.4		
Iron	0		
Aluminium	14.7		
Beryllium	0		
Cobalt	0		
Copper	1.4		
Lead	0		
Magnox/Magnesium	0		
Nickel	0		
Titanium	0		
Uranium	16.7	Radiography source shielding & calibration /experiments	
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	0		

Organics (%wt): Plastic is present in the form of perspex for beta shielding.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	0		
Paper, cotton	0		
Wood	0		
Halogenated plastics	6.1	PVC	
Total non-halogenated plastics	25.3		
Condensation polymers	25.3		
Others	0		
Organic ion exchange materials	0		
Total rubber	0		
Halogenated rubber	0		
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.....	0		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	5.5	Glass	
Graphite.....	0		
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): Present but not totalling more than 1% by weight.

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	<<0.10	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	0	
Nitrate.....	<<0.10	
Nitrite.....	0	
Phosphate.....	0	
Sulphate.....	<<0.10	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: -

	(%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	

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Corrosive materials.....	NE	
Pyrophoric materials.....	NE	
Generating toxic gases.....	NE	
Reacting with water.....	NE	
Higher activity particles.....	P	Source
Soluble solids as bulk chemical compounds.....	NE	

Hazardous substances / non hazardous pollutants: -

	(%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.....	0	
Boron.....	NE	
Boron (in Boral).....	NE	
Boron (non-Boral).....	NE	
Cadmium.....	NE	
Caesium.....	TR	
Selenium.....	NE	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....	0	
Tin.....	NE	
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	

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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	No complexing agents present in the waste stream.
Total complexing agents.....	0	

Potential for the waste to contain discrete items: No.

TREATMENT, PACKAGING AND DISPOSAL

Waste that is currently ILW: High activity Am-241 and Co-60 sources are recycled and not disposed as waste. In omitting these activities, the total specific activties exceed neither 4.00E-03 TBq/m3 alpha nor 1.20E-02 TBq/m3 beta. Decay storage is not undertaken at AWE for waste stream 7A32. Sealed and Unsealed sources are disposed shortly after being deemed redundant, as to satisfy the requirements of Licence Condition 32.

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		
Recyling / reuse	Off-site	~5.0
Other / various	Off-site	~95.0
None		

Comment on planned treatments: The bulk of the sources are consolidated at a Contractor's site and then sentenced through a final disposal solution, e.g. LLWR Burial, Combustion, Permitted LA-LLW, etc. Sources are re-used or recycled whenever possible. However, recycling/reuse tends to be available for higher activity sources, so the crux of the waste stream is shipped to an off-site Contractor's facility to be consolidated before final disposal.

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		
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	~5.0	0.29
Disposal route not known	~95.0	0.28

Classification codes for waste expected to be consigned to a landfill facility: -

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

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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: -

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: At present, the disposal does not fall under any of the above, as this waste stream is currently transferred to an off-site source disposal Contractor. This stance may alter in near distant future if/when the BAT option changes.

Waste Planned for Disposal at the LLW Repository: (Not applicable to this waste stream)

Container voidage: -

-

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: The source of activity could be from any number of radionuclides.

Uncertainty: The activity and radionuclides declared are not accurate, as they will vary depending on what requires disposal in any given year.

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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 activity levels are determined from the 2018-2021 disposal figures. Decay corrections have not been undertaken as it is assumed that new sources will be bought and eventually disposed.
Other information:	-

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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			~6.79E-05	D D 2	Gd 153				
Be 10					Ho 163				
C 14			~1.19E-07	D D 2	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			~7.55E-02	D D 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			~5.3E-06	D D 2	Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226			~1.8E-06	D D 2
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90			~6.97E-05	D D 2	Th 227				
Zr 93					Th 228			~2.34E-08	D D 2
Nb 91					Th 229				
Nb 92					Th 230			~2.65E-10	D D 2
Nb 93m					Th 232			~1.36E-09	D D 2
Nb 94					Th 234				
Mo 93					Pa 231			~5.92E-06	D D 2
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106			~5E-11	D D 2	U 233				
Pd 107					U 234			~3.48E-04	D D 2
Ag 108m					U 235			~1.17E-05	D D 2
Ag 110m					U 236			~1.2E-06	D D 2
Cd 109			~2.03E-09	D D 2	U 238			~5.08E-04	D D 2
Cd 113m					Np 237			~9.75E-08	D D 2
Sn 119m					Pu 236				
Sn 121m					Pu 238			~1.4E-03	D D 2
Sn 123					Pu 239			~1.73E-05	D D 2
Sn 126					Pu 240			~1.39E-09	D D 2
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241			~1.7E-02	D D 2
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137			~2.05E-04	D D 2	Cm 244				
Ba 133			~4.21E-08	D D 2	Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147			~4.51E-11	D D 2	Cf 251				
Sm 147					Cf 252			~1.47E-06	D D 2
Sm 151					Other a				
Eu 152			~5.02E-05	D D 2	Other b/g			~5.3E-05	D D 2
Eu 154					**Total a**	**0**		**~1.93E-02**	**D D 2**
Eu 155					**Total b/g**	**0**		**~7.60E-02**	**D D 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