WASTE STREAM 7A23 Operational LLW Requiring Further Assay Through the Recategorization Programme

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.....	40.0 m³
Future arisings -	1.4.2022 - 31.3.2080.....	0 m³
Total future arisings:		0 m³
Total waste volume:		40.0 m³

Comment on volumes: This waste stream comprises of waste that was unacceptable to LLWR for burial, but since the limit of 0.1 GBq/t Pu was rescinded, this waste needs to be re-assayed. Some HEU is present in this category due to the disparity between LLWR acceptance and the transport regulations for fissile materials. The forward programme for re-categorising this waste has progressed since the last UKRWI exercise in 2019. In-situ high resolution gamma-ray spectroscopy has been denounced as a possible assay method due to the waste being too dense, producing an unacceptable level of attenuation. Advice sought from the AWE Non-Destructive Assay Team has given rise to the employment of a Passive Neutron Coincident Counting measurement system. Once re-assayed and reassessed, waste from 7A23 will be transferred to either 7A21 or 7A27 waste streams.

Uncertainty factors on volumes:

Stock (upper):	x 2.0	Arisings (upper)	x
Stock (lower):	x 0.5	Arisings (lower)	x

WASTE SOURCE Organic and inorganic solids arising from operations with plutonium and uranium

PHYSICAL CHARACTERISTICS

General description: The waste consists of solids arising from operations with plutonium and uranium. These include tools, filters, glove-boxes, discarded and unusable equipment. It also includes some facility re-kit (refurbishment) wastes.

Physical components (%wt): Metal (38.0%), cellulosic material (6.7%), plastics (37.0%), non-organics (17.4%) and rubber (0.9%). The composition of this waste stream is unknown, so 7A21 has been used as a best estimate.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.26

Comment on density: This figure has been derived using 7A21 stock data, as composition of this waste stream is unknown.

CHEMICAL COMPOSITION

General description and components (%wt): Metal (38.0%), cellulosic material (6.7%), plastics (37.0%), non-organics (17.4%) and rubber (0.9%).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: May be present in the waste stream in very small specific activities in HTO, HT and organically bound forms
C-14: May be present in the waste stream in very small specific activities
Cl-36: May be present in the waste stream in very small specific activities
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: Np-237 likely to be present in waste stream in oxide form as daughter product of Am-241 alpha decay
Pu: Present in Waste Stream as oxide form

Metals and alloys (%wt): Sheet metal of approximately 4mm in thickness may be present arising from parts of glove-boxes and ductwork.

WASTE STREAM 7A23 Operational LLW Requiring Further Assay Through the Recategorization Programme

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	13.8		
Other ferrous metals	13.1		
Iron	NE		
Aluminium	2.9		
Beryllium	1.3		
Cobalt	0		
Copper	2.8	~1.0% (assumed to be in cable)	
Lead	2.5		
Magnox/Magnesium	0		
Nickel	0		
Titanium	0		
Uranium	NE	Present as a contaminant only	
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	1.6	Tin (0.5%) and filters (1.1%)	

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	6.7	Paper/fibreboard and cotton	
Paper, cotton	6.7		
Wood	0		
Halogenated plastics	20.9	PVC	
Total non-halogenated plastics	16.1		
Condensation polymers	16.1		
Others	0		
Organic ion exchange materials	0		
Total rubber	0.90		
Halogenated rubber	0.90		
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): -

WASTE STREAM 7A23 Operational LLW Requiring Further Assay Through the Recategorization Programme

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	TR		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	6.3		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	2.2		
Graphite.....	8.9		
Desiccants/Catalysts.....	0		
Asbestos.....	TR		
Non/low friable.....	TR		
Moderately friable.....	TR		
Highly friable.....	TR		
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	P	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	0	
Nitrate.....	P	
Nitrite.....	0	
Phosphate.....	0	
Sulphate.....	1.0	
Sulphide.....	<0.01	

Materials of interest for waste acceptance criteria: Beryllium, lead and asbestos are 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	
Non-putrescible wastes.....	P	Paper, fibreboard and cotton

WASTE STREAM 7A23 Operational LLW Requiring Further Assay Through the Recategorization Programme

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: Beryllium, lead and asbestos are 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	P	0.5% weight (recorded in metals' section)
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 7A23 Operational LLW Requiring Further Assay Through the Recategorization Programme

Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….	TR	
Other organic complexants.....	TR	The waste could contain trace organic complexing agents from decontamination operations.
Total complexing agents.....	TR	

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	~60.0
Incineration		
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		~40.0

Comment on planned treatments: Approximately 40% of the waste will not be acceptable for supercompaction owing to the fissile content being assayed as too high for LLW disposal.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	100.0	~0.26
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		

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):

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 7A23 Operational LLW Requiring Further Assay Through the Recategorization Programme

Opportunities for alternative disposal routing: No

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	100.0	12	4

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: Where acceptable, wastes will be supercompacted, thus minimising voidage. High fissile drums (HEU wastes) are not acceptable for supercompaction, so they will be loaded directly into a HHSIO

Waste Characterisation Form (WCH): It is not yet determined if the waste meets LLWR's Waste Acceptance Criteria (WAC).
The waste does not have a current WCH.

The waste needs to be re-assayed to confirm suitability for disposal at the LLWR.

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: Plutonium (principally) and uranium contaminated material.

Uncertainty: The gross alpha and gross beta activities for the in-stock wastes are accurate. The radionuclide breakdown has been estimated. Predicted waste activities are based on recent disposal data.

Definition of total alpha and total beta/gamma: Where totals are shown on the table of radionuclides activities, they are the sums of the listed alpha and beta/gamma emitting radionuclides.

Measurement of radioactivities: Typically, these wastes were assayed using PNCC (Pu drums), which (at the time) was not configured to differentiate between HAW and LLW or LRGS (HEU drums).

Other information: Some of this waste, once re-assayed, may be transferred to Waste Stream 7A21 (ILW Pu).

WASTE STREAM 7A23 Operational LLW Requiring Further Assay Through the Recategorization Programme

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		5			Gd 153				
Be 10		5			Ho 163				
C 14		5			Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36		5			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		5			Pb 210		5		
Co 60	1.48E-09	C C 2			Bi 208				
Ni 59					Bi 210m				
Ni 63		5			Po 210		5		
Zn 65		5			Ra 223		5		
Se 79					Ra 225		5		
Kr 81					Ra 226		5		
Kr 85					Ra 228		5		
Rb 87					Ac 227		5		
Sr 90		5			Th 227		5		
Zr 93					Th 228		5		
Nb 91					Th 229		5		
Nb 92					Th 230		5		
Nb 93m					Th 232		5		
Nb 94		5			Th 234		5		
Mo 93					Pa 231		5		
Tc 97					Pa 233		5		
Tc 99					U 232	1E-09	C C 2		
Ru 106		5			U 233		5		
Pd 107					U 234	1.11E-04	C C 2		
Ag 108m					U 235	3.56E-06	C C 2		
Ag 110m		5			U 236	4.6E-07	C C 2		
Cd 109					U 238	1.89E-07	C C 2		
Cd 113m					Np 237		5		
Sn 119m					Pu 236				
Sn 121m					Pu 238	7.58E-06	C C 2		
Sn 123					Pu 239	2.62E-04	C C 2		
Sn 126					Pu 240	6E-05	C C 2		
Sb 125		5			Pu 241	2.35E-06	C C 2		
Sb 126					Pu 242	7.2E-09	C C 2		
Te 125m					Am 241	8.19E-05	C C 2		
Te 127m					Am 242m				
I 129		5			Am 243				
Cs 134		5			Cm 242				
Cs 135		5			Cm 243				
Cs 137	9.71E-08	C C 2			Cm 244				
Ba 133		5			Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144		5			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**	**5.27E-04**	**C C 2**	**0**	
Eu 155					**Total b/g**	**2.45E-06**	**C C 2**	**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