WASTE STREAM 5H14 UKAEA LLW

SITE Culham

SITE OWNER United Kingdom Atomic Energy Authority

WASTE CUSTODIAN United Kingdom Atomic Energy Authority

WASTE TYPE LLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m^3
Future arisings -	1.4.2022 - 31.3.2023.....	~1.2 m^3
	1.4.2023 - 31.3.2040.....	~19.2 m^3
Total future arisings:		20.4 m^3
Total waste volume:		20.4 m^3

Comment on volumes: Arisings are an estimate only. The facility has not begun operations and therefore a more accurate estimate will not be possible until operational experience has been gained. Estimated as half a 200l drum per month.

Uncertainty factors on volumes:

Stock (upper):	x	Arisings (upper)	x 5.0
Stock (lower):	x	Arisings (lower)	x 0.2

WASTE SOURCE Waste will consist of tools and plant items and any waste outside of Incineration WAC. Waste will predominantly originate from the Hot Cell line once ILW has been seggregated.

PHYSICAL CHARACTERISTICS

General description: Mostly metals such as inconel, steel, copper and aluminium. Includes small and volume reduced items packaged in to 200 litre steel drums and large items not suitable for volume reduction. Waste is seggregated, sorted and size reduced where possible to enable packaging in to disposal packages and to confirm disposal route. Beryllium contamination may be tied down to protect waste operators.

Physical components (%wt): Metals (20%), other materials (80%).

Sealed sources: Not yet determined. Sealed sources may be included in the waste stream but will be re-used, recycled or returned to manufacturer where possible.

Bulk density (t/m^3): ~0.55

Comment on density: Individual packages vary, figure used is based on historical Net wt averages of a similar stream between 01/01/2010 and 01/04/2016.

CHEMICAL COMPOSITION

General description and components (%wt): Metals consisting of stainless, mild and galvanised steel, inconel, copper and aluminium (20%), other materials consisting of consumables, glass, rubble, concrete and graphite (80%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Mainly outgassed tritium present in the form of tritiated water vapour, and some absorbed into material surfaces.
C-14: Potentially present as activated graphite

Metals and alloys (%wt): Majority of metal present as size reduced items to enable packaging in 200l Steel Drums. <1% metal present as sheet and <5% bulk items. Dimensions of bulk items will vary but will be greater than 1mx1m.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~5.0	316 ~75%, other grades ~25%.	
Other ferrous metals.....	~5.0		
Iron.....			
Aluminium.....	~3.0		
Beryllium.....	<0.01		

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Cobalt	<0.30	As part of specialist alloys.
Copper	~1.5	
Lead	<0.10	
Magnox/Magnesium	TR	As part of specialist alloys.
Nickel	~2.0	Inconel 90%, pure nickel and other specialist alloys 10%.
Titanium	<<1.0	
Uranium	0	
Zinc	~2.0	
Zircaloy/Zirconium	TR	Not expected but may be present as part of specialist alloys
Other metals	<0.10	Small quantities of silver and other metals may be present.

Organics (%wt): Possible that a very small quantity (by weight) of PVC could be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	~20.0		
Paper, cotton	~18.0		
Wood	~2.0		
Halogenated plastics	~10.0		
Total non-halogenated plastics	~20.0		
Condensation polymers	~15.0		
Others	~5.0		
Organic ion exchange materials	TR		
Total rubber	~5.0		
Halogenated rubber	~2.0		
Non-halogenated rubber	~3.0		
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	~~10.0		

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	0		
Inorganic sludges and flocs	~5.0		
Soil	0		
Brick/Stone/Rubble	<1.0		
Cementitious material	~1.0		
Sand	~1.0		
Glass/Ceramics	<6.0		

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Graphite	~1.0	
Desiccants/Catalysts	TR	
Asbestos	TR	May be present in individual packages at trace levels.
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): No inorganic anions are present.

	(%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: Beryllium dust contamination is present. There may be some solid beryllium items included in this stream which account for the <0.3% by wt.

	(%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	
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	

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Hazardous substances / non hazardous pollutants: Beryllium dust is typically present at < 0.1% by weight, solid beryllium may be present in individual packages above 0.1%.

	(%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	0	
Arsenic	0	
Barium	0	
Boron	P	Included as boronated concrete.
Boron (in Boral)	P	
Boron (non-Boral)	0	
Cadmium	0	
Caesium	0	
Selenium	0	
Chromium	P	Included in specialist steels.
Molybdenum	P	Included in specialist steels.
Thallium	0	
Tin	P	Included in solders.
Vanadium	P	Included in specialist steels.
Mercury compounds	0	
Others	P	
Electronic Electrical Equipment (EEE)		
EEE Type 1	P	
EEE Type 2	P	
EEE Type 3	P	
EEE Type 4	0	
EEE Type 5	P	

Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA	0	
DPTA	0	
NTA	0	
Polycarboxylic acids	0	
Other organic complexants	0	
Total complexing agents	0	

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Potential for the waste to contain discrete items: Yes. Yes, discrete items may be included but not expected in large quantities.

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	~50.0
Incineration		
Solidification		
Decontamination		
Metal treatment	Off-site	~10.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		~40.0

Comment on planned treatments: Drummed waste will be supercompacted, bulk undrummed waste expected to be consigned in a third height ISO.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~90.0	~~0.55
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	~10.0	~~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: -

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			

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:

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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	90.0	<9.3	2

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: <10%

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).

Waste consigned for disposal to LLWR in year of generation: No. There will always be a quantity of waste collected towards the end of a year which is not processed for disposal until the following year. Quite likely that this type of waste will not be despatched for a year after generation.

Non-Containerised Waste for In-Vault Grouting:

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: The main sources of activity are beta/gamma contamination and neutron activation. Loose activated carbon/beryllium dust contaminating material surfaces possible.

Uncertainty: Nuclide activities are only indicative and relate to operational waste already analysed at JET for similar streams, further information will be vailable once the facility begins operations.

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: Nuclide activities are only indicative and relate to operational waste already analysed at JET for similar streams, further information will be vailable once the facility begins operations.

Other information: -

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		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				
Ag 108m					U 235				
Ag 110m					U 236				
Cd 109					U 238				
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				5
Eu 152					Other b/g			~4E-03	C C 2
Eu 154					**Total a**	**0**		**0**	**5**
Eu 155					**Total b/g**	**0**		**~4E-03**	**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