

<b>WASTE STREAM</b>	<b>5H16</b>	<b>H3AT Incinerable</b>
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**SITE** Culham

**SITE OWNER** United Kingdom Atomic Energy Authority

**WASTE CUSTODIAN** United Kingdom Atomic Energy Authority

**WASTE TYPE** LLW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>
Future arisings -	1.4.2020 - 31.3.2035.....	~~111.0 m <sup>3</sup>
Total future arisings:		111.0 m <sup>3</sup>
Total waste volume:		111.0 m <sup>3</sup>

Comment on volumes: This is a new facility yet to be constructed and therefore uncertainty in volumes of waste to be produced is high. A similar facility on site has been used to estimate volumes, but, a more accurate estimate is not possible until operational experience has been gained.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 2.0  
 Stock (lower): x Arisings (lower) x 0.5

**WASTE SOURCE** H3AT tritium operations resulting in tritium contamination of waste.

**PHYSICAL CHARACTERISTICS**

General description: Protective clothing, swabs, plastic wrappings, masks, plastic isolation tents. Waste is segregated, sampled and low force compacted to reduce storage volumes and confirm disposal routes.

Physical components (%wt): Clothing, swabs, wrappings, masks, plastics (polythene sheet) floor coverings, plastic isolation tents. Estimate plastic (74%), cellulose (4%), rubber (4%), with very small quantity of metal (i.e. on masks and in wellington boot toe caps). Organic Liquids (17%), metals (<1%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~0.36

Comment on density: Figure used is based on historical Net wt averages of all packages generated as part of a related waste stream between 01/01/2010 and 31/03/2016.

**CHEMICAL COMPOSITION**

General description and components (%wt): Plastic (74%), rubber (4%), cellulose including wood (4%), organic liquids (17%), metals (1%) and traces of graphite and beryllium.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Mainly outgassed tritium present in the form of tritiated water vapour.

Metals and alloys (%wt):

Stainless steel.....	~0.20	316
Other ferrous metals.....	~0.80	Mild steel.
Iron.....	TR	
Aluminium.....	TR	
Beryllium.....	<<0.10	
Cobalt.....	0	
Copper.....	TR	
Lead.....	0	
Magnox/Magnesium.....	0	
Nickel.....	TR	Inconel.
Titanium.....	0	
Uranium.....	0	

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	Zinc.....	TR
	Zircaloy/Zirconium.....	0
	Other metals.....	NE
Organics (%wt):	The waste contains cellulose in the form of cotton and paper oversuits, halogenated plastics as PVC and non-halogenated plastics as polythene and polyester. In general the use of halogenated plastics is minimised at JET, although a small quantity may be present as indicated.	
	Total cellulosics.....	4.0
	Paper, cotton.....	~3.0
	Wood.....	~1.0
	Halogenated plastics .....	9.0
	Total non-halogenated plastics.....	65.0
	Condensation polymers.....	~65.0
	Others.....	P
	Organic ion exchange materials....	NE
	Total rubber.....	4.0
	Halogenated rubber .....	~2.0
	Non-halogenated rubber.....	~2.0
	Hydrocarbons.....	17.0
	Oil or grease .....	17.0
	Fuel.....	TR
	Asphalt/Tarmac (cont.coal tar)...	TR
	Asphalt/Tarmac (no coal tar)....	TR
	Bitumen.....	TR
	Others.....	TR
	Other organics.....	TR
Other materials (%wt):	-	
	Inorganic ion exchange materials.	0
	Inorganic sludges and flocs.....	0
	Soil.....	0
	Brick/Stone/Rubble.....	0
	Cementitious material.....	0
	Sand.....	0
	Glass/Ceramics.....	
	Graphite.....	TR
	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.....	TR
Inorganic anions (%wt):	No inorganic anions are present.	

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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, low flash point liquids may be present in trace amounts from specific experiments.

Combustible metals.....	0	
Low flash point liquids.....	P	Present in trace amounts only.
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	<1.0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	<1.0	Less than 1% by wt.
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:

Beryllium metal dust is present at a level of less than 0.1% by weight.

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.....	TR	May be present in trace amounts

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as boronated concrete.

Cadmium.....	0
Caesium.....	0
Selenium.....	0
Chromium.....	TR
Molybdenum.....	TR
Thallium.....	0
Tin.....	TR
Vanadium.....	0
Mercury compounds.....	0
Others.....	<0.10
<b>Electronic Electrical Equipment (EEE)</b>	
EEE Type 1.....	TR
EEE Type 2.....	0
EEE Type 3.....	0
EEE Type 4.....	0
EEE Type 5.....	0
Complexing agents (%wt):	No
EDTA.....	0
DPTA.....	0
NTA.....	0
Polycarboxylic acids.....	0
Other organic complexants.....	0
Total complexing agents.....	0

Included in specialist steels as possible trace contaminants.

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Potentially included as trace amounts of tin plated pins/connectors.

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	82.0
Supercompaction (HFC)		
Incineration	Off-site	100.0
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		

Comment on planned treatments:

-

**WASTE STREAM****5H16****H3AT Incinerable****Disposal Routes:**

Disposal Route	Stream volume %
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	100.0

**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:** (Not applicable to this waste stream)

Container	Stream volume %	Waste loading m <sup>3</sup>	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: Waste packaged in various containers destroyed during incineration.

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

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: -

Potential for the waste to contain discrete items: -

**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:	The main sources of activity are tritium contamination and neutron activation.
Uncertainty:	Historical package averages from a related waste stream are used to estimate future arisings. Significant uncertainty as facility yet to be operational and experimental programme yet to be determined.
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:	Activity assessments are achieved by documented methods including on and off site pyrolysis followed by liquid scintillation counting. Stock Neutron activation activity levels determined by Gamma Spectroscopy. Historical package averages are used to estimate future arisings.
Other information:	Wastes may also be contaminated with activated metals and graphite.

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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			~1.2E-02	B 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				
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				
Eu 152					Other b/g				
Eu 154					<b>Total a</b>	<b>0</b>		<b>0</b>	
Eu 155					<b>Total b/g</b>	<b>0</b>		<b>~1.2E-02</b>	<b>B C 2</b>

**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