

<b>WASTE STREAM</b>	<b>5H12</b>	<b>UKAEA 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

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	0 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2040.....	~~170.0 m <sup>3</sup>
Total future arisings:		170.0 m <sup>3</sup>
Total waste volume:		170.0 m <sup>3</sup>

Comment on volumes: New stream for the UKAEA Materials Research Facility (MRF) running from 2022 to 2040, the facility arisings will depend on research requirements of the UK and European nuclear industry and therefore are uncertain at this time. The MRF is forecast to run for 20 years with active operations beginning in 2019, volumes are expected to be ~200l per week but will depend on the operational activities in the facility.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.5  
 Stock (lower): x Arisings (lower) x 0.1

**WASTE SOURCE** Neutron activated and tritium contaminated nuclear components used for research, original source includes nuclear facilities in the UK and Europe.

**PHYSICAL CHARACTERISTICS**

General description: Protective clothing, swabs, plastic wrappings, masks, plastic isolation tents. Waste is cleaned, segregated, sorted, sampled and size reduced where possible to enable packaging in to disposal packages and to confirm disposal route.

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>): ~0.05

Comment on density: Bulk density is an estimate based on expected arisings assuming no in-drum low force compaction.

**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, and some absorbed into material surfaces.

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~0.20		
Other ferrous metals.....	~0.80		
Iron.....	TR		
Aluminium.....	TR		
Beryllium.....	<<0.10		
Cobalt.....	TR		
Copper.....	TR		

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Lead.....	0
Magnox/Magnesium.....	TR
Nickel.....	TR
Titanium.....	TR
Uranium.....	NE
Zinc.....	TR
Zircaloy/Zirconium.....	TR
Other metals.....	TR

Organics (%wt):

The waste contains cellulose in the form of cotton and paper overalls, halogenated plastics as PVC and non-halogenated plastics as polythene and polyester. In general the use of halogenated plastics will be minimised, although a small quantity may be present as indicated.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	13.0		
Paper, cotton.....	~12.0		
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.....	~5.0		
Oil or grease .....	~2.0		
Fuel.....	0		
Asphalt/Tarmac (cont.coal tar)...	0		
Asphalt/Tarmac (no coal tar)....	0		
Bitumen.....	0		
Others.....	3.0	Potential inclusion of electropolishing brighteners.	
Other organics.....	P		

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	~1.0	Dried polishing fluids	
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	TR		

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Desiccants/Catalysts.....	0	
Asbestos.....	0	
Non/low friable.....	0	
Moderately friable.....	0	
Highly friable.....	0	
Free aqueous liquids.....	~1.0	Diamond cutting fluids.
Free non-aqueous liquids.....	~1.0	Diamond cutting fluids.
Powder/Ash.....	0	

Inorganic anions (%wt):           No inorganic anions are expected in this waste stream.

	(%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:           -

	(%wt)	Type(s) and comment
Combustible metals.....	TR	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	NE	
Biological etc. materials.....	0	
Biodegradable materials.....	NE	
Putrescible wastes.....	NE	
Non-putrescible wastes.....	NE	
Corrosive materials.....	P	Sodium hydroxide (NaOH) potentially present in trace amounts.
Pyrophoric materials.....	NE	
Generating toxic gases.....	0	
Reacting with water.....	NE	
Higher activity particles.....	0	Beta/gamma active particles present.
Soluble solids as bulk chemical compounds.....	0	

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Hazardous substances /  
non hazardous pollutants: -

	(%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.....	NE	
Boron (in Boral).....	NE	
Boron (non-Boral).....	NE	
Cadmium.....	NE	
Caesium.....	0	
Selenium.....	0	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....	0	
Tin.....	NE	
Vanadium.....	NE	
Mercury compounds.....	0	
Others.....	P	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	~1.0	
EEE Type 2.....	0	
EEE Type 3.....	0	
EEE Type 4.....	0	
EEE Type 5.....	0	

Complexing agents (%wt): Not yet determined

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

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Potential for the waste to contain discrete items:

Yes. Potentially; but destroyed during treatment

**TREATMENT, PACKAGING AND DISPOSAL**

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 Recycling / reuse Other / various None	Off-site	100.0

Comment on planned treatments:

-

**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 Disposal route not known	100.0	

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:** (Not applicable to this waste stream)

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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 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: -

**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: Activity is expected to originate from activated metal dust contamination of consumables and PPE.

Uncertainty: Currently there are large uncertainties in the specific activity of the waste as this will depend on the nature of samples submitted for analysis and the operational programme of the facility.

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: Activities are estimates only. Once operations commence specific and total activities for the waste stream will be determined by gamma spectroscopy and other relevant techniques based on the radiochemical nature of samples (e.g. acid dissolution followed by liquid scintillation counting).

Other information: -

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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				6	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				6	Pb 205				
Fe 55				6	Pb 210				
Co 60				6	Bi 208				
Ni 59				6	Bi 210m				
Ni 63				6	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		~-6E-04	AD	2
Eu 154					<b>Total a</b>	<b>0</b>	<b>0</b>		<b>5</b>
Eu 155					<b>Total b/g</b>	<b>0</b>	<b>~-6E-04</b>	<b>AD</b>	<b>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