

<b>WASTE STREAM</b>	<b>5H301</b>	<b>JET Decommissioning Non-Activated ILW</b>
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**SITE** Culham

**SITE OWNER** United Kingdom Atomic Energy Authority

**WASTE CUSTODIAN** United Kingdom Atomic Energy Authority

**WASTE TYPE** ILW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

	Reported
Stocks: At 1.4.2022.....	0 m <sup>3</sup>
Future arisings - 1.4.2027 - 31.3.2030.....	~8.2 m <sup>3</sup>
Total future arisings:	8.2 m <sup>3</sup>
Total waste volume:	8.2 m <sup>3</sup>

Comment on volumes: This waste is from decommissioning so the annual arisings will vary with the plans and progress. These have yet to be developed as the JET facilities are still operational. The current assumption is that the JET experimental programme ends at the end of 2023 so decommissioning commences in 2024. This waste stream will arise during the latter part of decommissioning principally from the decommissioning of the tritium handling facility during the period 2027 to 2030. The quantity might vary as a result of the JET programme.

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

**WASTE SOURCE** Tritiated but not neutron activated waste arising principally from the decommissioning of the Active Gas Handling System.

**PHYSICAL CHARACTERISTICS**

General description: The waste will be largely redundant stainless steel plant and equipment. The items will vary in size. All large items will be size reduced in order to be accommodated in suitable disposal containers. It is expected that waste will be processed on-site as per operational non-activated ILW by size reduction. Exact processing methods are to be determined.

Physical components (%wt): Waste is predominantly internal pipework from the Active Gas Handling facility (>50%) and depleted uranium beds (and related structures) (<50%) used for tritium storage.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~1

Comment on density: The bulk density of operational ILW has been used as an estimation of bulk density for this waste stream, assuming similar processing is undertaken on-site. Process is yet to be optimised.

**CHEMICAL COMPOSITION**

General description and components (%wt): Stainless steel (90%), carbon steel (8%), depleted uranium (<1%), others (1%).

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.  
 U: Hydride, tritide, deuteride and depleted.

Metals and alloys (%wt): The metallic items are large scale fabrications from plate and bulk items including pipework and pumps. It is estimated that sheet metal will be less than 2% by weight.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~90.0	316 ~95%, other grades ~5%.	
Other ferrous metals.....	~8.0	Mild Steel (100%).	
Iron.....	0		
Aluminium.....	TR		
Beryllium.....	TR	Beryllium contamination may be present in individual packages.	

<b>WASTE STREAM</b>	<b>5H301</b>	<b>JET Decommissioning Non-Activated ILW</b>
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Cobalt.....	0	
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	0	
Nickel.....	0	
Titanium.....	0	
Uranium.....	<1.0	Depleted Uranium.
Zinc.....	0	
Zircaloy/Zirconium.....	0	
Other metals.....	~1.0	

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

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	TR		
Paper, cotton.....	TR		
Wood.....	TR		
Halogenated plastics .....	TR		
Total non-halogenated plastics.....	TR		
Condensation polymers.....	TR		
Others.....	TR		
Organic ion exchange materials....	0		
Total rubber.....	TR		
Halogenated rubber .....	TR		
Non-halogenated rubber.....	TR		
Hydrocarbons.....	TR		
Oil or grease .....	TR		
Fuel.....	0		
Asphalt/Tarmac (cont.coal tar)...	0		
Asphalt/Tarmac (no coal tar)....	0		
Bitumen.....	0		
Others.....	0		
Other organics.....	TR		

Other materials (%wt):                      -

	(%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.....	0		
Graphite.....	0		

<b>WASTE STREAM</b>	<b>5H301</b>	<b>JET Decommissioning Non-Activated ILW</b>
---------------------	--------------	--

Desiccants/Catalysts.....	<1.0	Palladium/Platinum catalysts may be present as part of this waste stream. Included in "other metals".
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):           No Inorganic anions are expected to be present in the 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:           Pyrophoric uranium hydride is present in tritium process plant (0.005%).

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	P	Uranium hydrides, deuterides and tritides are likely to be present in trace levels following tritium extraction from depleted uranium storage beds.
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	0	
Corrosive materials.....	0	
Pyrophoric materials.....	P	Uranium hydrides, deuterides and tritides are likely to be present in trace levels following tritium extraction from depleted uranium storage beds.
Generating toxic gases.....	0	
Reacting with water.....	0	

<b>WASTE STREAM</b>	<b>5H301</b>	<b>JET Decommissioning Non-Activated ILW</b>
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Higher activity particles.....	0
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / non hazardous pollutants:      Beryllium dust may be present in individual packages at << 0.1% by weight

	(%wt)	
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.....	0	
Boron (in Boral).....	0	
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 solder.
Vanadium.....	P	Included in specialist steels.
Mercury compounds.....	0	
Others.....	P	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	0	
EEE Type 2.....	0	
EEE Type 3.....	0	
EEE Type 4.....	0	
EEE Type 5.....	0	

Complexing agents (%wt):      No

	(%wt)	
EDTA.....	0	
DPTA.....	0	
NTA.....	0	

<b>WASTE STREAM</b>	<b>5H301</b>	<b>JET Decommissioning Non-Activated ILW</b>
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Polycarboxylic acids..... 0  
 Other organic complexants..... 0  
 Total complexing agents..... 0

Potential for the waste to contain discrete items: Yes.

**PACKAGING AND CONDITIONING**

Conditioning method: To be determined. Waste may be pre-treated to remove tritium.

Plant Name: JET decommissioning waste packaging facility.

Location: Culham

Plant startup date: ~2025

Total capacity (m<sup>3</sup>/y incoming waste): NE

Target start date for packaging this stream: -

Throughput for this stream (m<sup>3</sup>/y incoming waste): NE

Other information: Plant start date may change with date of termination of JET operations.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	6m <sup>3</sup> concrete box (HD)	100.0	~4.1	~5.0	2

Likely container type comment: There is an opportunity to improve the packing factor and thus reduce the final number of packages. This will be explored in more detail once the initial packaging concept has been agreed in principle.

Range in container waste volume: This will depend on the activity of the waste item(s).

Other information on containers: -

Likely conditioning matrix: Polymer

Other information: -

Conditioned density (t/m<sup>3</sup>): ~2.0

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: Not yet determined

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

**RADIOACTIVITY**

Source: Source of radioactivity is from tritium contamination.

Uncertainty: Activity levels of this waste will depend on the success of the decontamination to reduce the tritium inventory.

**WASTE STREAM****5H301****JET Decommissioning Non-Activated ILW**

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:

Tritium activities will be estimated using specific sampling plans utilising destructive sampling and historical experience.

Other information:

This waste stream is from the tritium processing plant so the principal activity is from tritium contamination. Within this waste stream there will be the tritium storage beds which are made from depleted uranium. Their volume is very small compared with the total volume of this stream.

**WASTE STREAM**

**5H301**

**JET Decommissioning Non-Activated ILW**

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			~1.3E+01	CC 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		~~3E-04	AA 2	
Ag 108m					U 235		~~1.3E-05	AA 2	
Ag 110m					U 236				
Cd 109					U 238		~~3E-04	AA 2	
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>	~~6.13E-04	AA 2	
Eu 155					<b>Total b/g</b>	<b>0</b>	~1.3E+01	CC 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