WASTE STREAM 5H302 JET Decommissioning Tritiated Non-Activated 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 -	1.4.2024 - 31.3.2027.....	~663.0 m^3
	1.4.2027 - 31.3.2028.....	~141.0 m^3
Total future arisings:		804.0 m^3
Total waste volume:		804.0 m^3

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. .It is assumed that the JET Experimental Programme is completed at the end of 2023. Decommissioning on this basis starts in 2024. It is planned that decommissioning will be completed at the end of 2033.

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

WASTE SOURCE The waste arises from the decommissioning of the JET facilities.

PHYSICAL CHARACTERISTICS

General description: This waste will comprise steel and other metallic items contaminated with tritium mainly from the Active Gas Handling System and other areas. There will also be some secondary waste from the decommissioning operations. It is planned that large items will be size reduced in order to be accommodated within LLW ISO containers / 200l steel drums. It is expected that waste will be processed on-site as per operational non-activated LLW by size reduction. Exact processing methods are to be determined.

Physical components (%vol): Cold boxes (stainless steel), steel catwalks, electric cables, ventilation plant, laboratory furniture and others. The percentage breakdown has yet to be completed. Some of this waste could come from the torus hall and diagnostic equipment.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): ~~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): The waste comprises metallic LLW from decommissioning/dismantling as well as secondary waste arisings. The proportion and form of the tritium in the components is not currently known.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Gas or oxide.
U: There is a remote possibility that a very small quantity of this waste stream might have some contamination from the tritium storage beds which are uranium.

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.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	~50.0	316 ~75%, other grades ~25%.	
Other ferrous metals	~19.0		
Iron	~1.0		
Aluminium	~11.0		
Beryllium	<0.30		
Cobalt	<1.0	As part of specialist alloys.	
Copper	~7.0		
Lead	<0.10		
Magnox/Magnesium	TR	As part of specialist alloys.	
Nickel	~3.0		
Titanium	<<1.0		
Uranium	TR		
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): The extent of organic materials is not estimated. This stream will contain secondary waste from the decommissioning operational work. Total organics and other materials ~~7% including secondary waste arisings.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	P		
Paper, cotton	P		
Wood	P		
Halogenated plastics	P		
Total non-halogenated plastics	P		
Condensation polymers	P		
Others	P		
Organic ion exchange materials	0		
Total rubber	P		
Halogenated rubber	P		
Non-halogenated rubber	P		
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	P		

Other materials (%wt): -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	P		
Soil.....	0		
Brick/Stone/Rubble.....	P		
Cementitious material.....	P		
Sand.....	P		
Glass/Ceramics.....	P		
Graphite.....	P		
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 expected to be 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 is typically present at < 0.1% by weight, solid beryllium may be present in individual packages above 0.1%. Low flash point liquids may be present in trace amounts from specific experiments.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	P	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	P	

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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	

Hazardous substances / non hazardous pollutants: The existence of toxic metals will be estimated more accurately in future. The levels of beryllium are expected to be low for most of the waste arising from the AGHS but could be present in waste from the Torus Hall.

	(%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.....	P	Potentially present in trace amounts as arsenides in specialist semiconductors / electronics.
Barium.....	0	
Boron.....	P	Included as boronated concrete.
Boron (in Boral).....	0	
Boron (non-Boral).....	P	
Cadmium.....	P	Potentially present in trace amounts in specialist semiconductors / electronics / solders.
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	

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EEE Type 4..... 0

EEE Type 5..... P

Complexing agents (%wt): Not yet determined

	(%wt)	Type(s) and comment
EDTA.....	0	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids…….	TR	
Other organic complexants.....	TR	None expected from the primary waste stream but there may be some from secondary waste (e.g. protective clothing, swabs, cleaning materials).
Total complexing agents.....	TR	

Potential for the waste to contain discrete items: Yes.

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	~~5.0
Supercompaction (HFC)	Off-site	~~15.0
Incineration		
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		~~80.0

Comment on planned treatments: Treatment methods will depend on the exact nature of the waste which is not known at this stage. It is expected that the majority of secondary waste will be compacted on-site prior to disposal for incineration.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~~15.0	~~1.0
Expected to be consigned to a Landfill Facility	~~72.0	~~1.0
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	~~5.0	~~1.0
Expected to be consigned to a Metal Treatment Facility		
Expected to be consigned as Out of Scope	~~8.0	~~1.0
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):

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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:

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	~15.0	~14.5	9

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: Expected to be <10%. No data available.

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.

Yet to arise

Waste consigned for disposal to LLWR in year of generation: Yes.

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: Tritium contamination of process plant components.

Uncertainty: This waste will come from a plant which is still operational so the detailed information is not available.

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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:	These cannot be determined until the end of the JET project. Sampling and measurement will be used to characterise this waste.
Other information:	Tritium will be the dominant radionuclide. Specific activity will be determined at the time of decommissioning. Other nuclide activities have not been estimated but will be as part of the categorisation of the waste.

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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			<1.2E-04	A D 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				8
Ag 108m					U 235				8
Ag 110m					U 236				8
Cd 109					U 238				8
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					**Total a**	**0**		**NE**	**8**
Eu 155					**Total b/g**	**0**		**<1.2E-04**	**A D 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