WASTE STREAM 5H10 JET LA-LLW

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.....	~30.0 m³
Future arisings -	1.4.2019 - 31.3.2020.....	~3.0 m³
	1.4.2020 - 31.3.2021.....	~2.0 m³
	1.4.2021 - 31.3.2022.....	~1.0 m³
Total future arisings:		6.0 m³
Total waste volume:		36.0 m³

Comment on volumes: As this is an operational waste stream the arisings will not be constant and will depend on the JET experimental programme, maintenance activities and breakdowns. It is assumed that the JET Experimental Programme is completed at the end of 2020. Decommissioning on this basis starts in 2021.

Uncertainty factors on volumes:

Stock (upper):	x 2.0	Arisings (upper)	x 2.0
Stock (lower):	x 0.5	Arisings (lower)	x 0.5

WASTE SOURCE Ex torus items and other hard materials generated from engineering operations. Tritium contaminated and potentially neutron activated waste.

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, sampled 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 (~84%), other materials (~16%)

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.78

Comment on density: Individual packages vary, figure used is based on historical Net wt averages of all packages generated as part of the waste stream between 01/01/2008 to 01/04/2016.

CHEMICAL COMPOSITION

General description and components (%wt): Metals consisting of stainless, mild and galvanised steel, inconel, copper and aluminium (84%), other materials consisting of graphite, CFC, glass, rubble and concrete (16%).

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): 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.

Stainless steel.....	~22.0	316 ~75%, other grades ~25%.
Other ferrous metals.....	~24.0	
Iron.....	~1.0	
Aluminium.....	~11.0	
Beryllium.....	<<0.10	
Cobalt.....	TR	As part of specialist alloys.
Copper.....	~8.0	
Lead.....	<0.10	
Magnox/Magnesium.....	TR	As part of specialist alloys.

WASTE STREAM	5H10	JET LA-LLW	
	Nickel	~6.0	Inconel 90%, pure nickel and other specialist alloys 10%.
	Titanium	<<1.0	
	Uranium	0	
	Zinc	~11.0	
	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.		
	Total cellulosics	TR	
	Paper, cotton	TR	
	Wood	TR	
	Halogenated plastics	TR	
	Total non-halogenated plastics	TR	
	Condensation polymers	TR	
	Others	TR	
	Organic ion exchange materials	TR	
	Total rubber	TR	
	Halogenated rubber	TR	
	Non-halogenated rubber	TR	
	Hydrocarbons	TR	
	Oil or grease	TR	
	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.	<0.50	
	Inorganic sludges and flocs	~1.0	
	Soil	0	
	Brick/Stone/Rubble	<0.20	
	Cementitious material	~0.50	
	Sand	~1.0	
	Glass/Ceramics	<1.0	
	Graphite	~10.0	Includes 3% Graphite and 7% Carbon Fibre Composite.
	Desiccants/Catalysts	TR	
	Asbestos	<1.5	
	Non/low friable	<1.0	
	Moderately friable	<0.50	
	Highly friable	TR	
	Free aqueous liquids	0	

WASTE STREAM 5H10 JET LA-LLW

	Free non-aqueous liquids..... 0	
	Powder/Ash..... 0	
Inorganic anions (%wt):	No inorganic anions are present.	
	Fluoride..... <<1.0	
	Chloride..... <<1.0	
	Iodide..... 0	
	Cyanide..... 0	
	Carbonate..... 0	
	Nitrate..... 0	
	Nitrite..... 0	
	Phosphate..... 0	
	Sulphate..... <<1.0	
	Sulphide..... 0	
Materials of interest for waste acceptance criteria:	Beryllium dust contamination is present much less than 0.1% by mass.	
	Combustible metals..... 0	
	Low flash point liquids..... 0	
	Explosive materials..... 0	
	Phosphorus..... 0	
	Hydrides..... TR	Potentially present in trace amounts as nickel metal hydride batteries.
	Biological etc. materials..... 0	
	Biodegradable materials..... 0	
	Putrescible wastes..... 0	
	Non-putrescible wastes..... 0	
	Corrosive materials..... <<1.0	Potentially present in trace amounts as acid/alkaline batteries.
	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 dust is typically present at < 0.1% by weight.	
	Acrylamide..... 0	
	Benzene..... 0	
	Chlorinated solvents..... 0	
	Formaldehyde..... 0	
	Organometallics..... 0	
	Phenol..... 0	
	Styrene..... 0	
	Tri-butyl phosphate..... 0	

WASTE STREAM 5H10 JET LA-LLW

Other organophosphates.....	0	
Vinyl chloride.....	0	
Arsenic.....	TR	Potentially present in trace amounts as arsenides in specialist semiconductors / electronics.
Barium.....	0	
Boron.....	TR	Included as boronated concrete.
Cadmium.....	TR	Potentially present in trace amounts in specialist semiconductors / electronics / solders.
Caesium.....	0	
Selenium.....	0	
Chromium.....	~~2.0	Included in specialist steels.
Molybdenum.....	<1.0	Included in specialist steels.
Thallium.....	0	
Tin.....	TR	Included in solders.
Vanadium.....	TR	Included in specialist steels.
Mercury compounds.....	TR	
Others.....	TR	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	~1.0	
EEE Type 2.....	~1.0	
EEE Type 3.....	~1.0	
EEE Type 4.....	TR	
EEE Type 5.....	TR	
Complexing agents (%wt):	Yes	
EDTA.....	0	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids……	TR	
Other organic complexants.....	TR	Trace quantities of complexing agents may be present from cleaning solutions.
Total complexing agents.....	TR	

TREATMENT, PACKAGING AND DISPOSAL

WASTE STREAM 5H10 JET LA-LLW

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		
Recyling / reuse		
Other / various		
None		100.0

Comment on planned treatments: -

Disposal Routes:

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	
Expected to be consigned to a Landfill Facility	100.0
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	

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 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			

Other information: Not forecast for disposal to LLWR.

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

Container voidage: -

Waste Characterisation Form (WCH): -

WASTE STREAM 5H10 JET LA-LLW

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

Source:	The main sources of activity are tritium contamination and neutron activation. Loose activated carbon/beryllium dust contaminating material surfaces.
Uncertainty:	Nuclide activities are only indicative and relate to operational waste already analysed by JET. In the future the activities may increase according to changes in the experimental programme and related, further exposure to activating neutrons.
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 are based on combustion followed by liquid scintillation counting and gamma spectroscopy. Future neutron activation and tritium contamination levels will be determined by the experimental programme.
Other information:	-

WASTE STREAM 5H10 JET LA-LLW

Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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	~2.6E-04	A B 3	~1.9E-04	A B 3	Gd 153				
Be 10					Ho 163				
C 14			~5E-08	C C 2	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			~4E-08	C C 2	Pb 205				
Fe 55	~3E-06	C C 2	~1.4E-04	A B 3	Pb 210				
Co 60	~1E-06	C C 2	~1.4E-04	A B 3	Bi 208				
Ni 59			~6E-07	C C 2	Bi 210m				
Ni 63	~3E-06	C C 2	~4E-05	C C 2	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			~8E-07	C C 2	Th 229				
Nb 92					Th 230				
Nb 93m			~6E-05	C C 2	Th 232				
Nb 94			~2E-06	C C 2	Th 234				
Mo 93			~1E-07	C C 2	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			~5E-08	C C 2
Eu 154					**Total a**	**0**		**0**	
Eu 155					**Total b/g**	**~2.67E-04**	**A B 3**	**~5.74E-04**	**A B 3**

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