

WASTE STREAM	1A03	LLW Non-Compactable Non-Drummable
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SITE Amersham
SITE OWNER GE Healthcare Limited
WASTE CUSTODIAN GE Healthcare Limited
WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	179.0 m ³
Future arisings -	1.4.2019 - 31.3.2030.....	~~527.0 m ³
Total future arisings:		527.0 m ³
Total waste volume:		706.0 m ³

Comment on volumes: Rate of arising varies due to waste being produced as a result of various decommissioning programmes. Future arising predictions based on project forecast of waste from decommissioning programmes used for the WCH for stream 1A03. Waste will be streamed where possible to LALLW and Out of Scope.

Uncertainty factors on volumes:	Stock (upper):	x 1.5	Arisings (upper)	x 1.5
	Stock (lower):	x 0.5	Arisings (lower)	x 0.5

WASTE SOURCE The waste is generated as a result of the site decommissioning programme to remove redundant buildings and facilities that have been used to manufacture a variety of industrial, pharmaceutical and life science products. Radioactivity is present as contamination and activation and includes a wide mixture of nuclides.

PHYSICAL CHARACTERISTICS

General description: The waste consists of redundant steel and fibreglass enclosures and associated ductwork wrapped in PVC layflat. Solids are of variable density and compressibility. There are no items requiring special handling.

Physical components (%wt): Metals (74 wt%), plastics (22 wt%), cellulose (2 wt%), rubber (1%wt) others (<1 wt%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.2

Comment on density: The waste has a density range of 0.1-2.0 t/m³ as stored. The mean density is not weighted.

CHEMICAL COMPOSITION

General description and components (%wt): Metals (74 wt%), plastics (22 wt%), cellulose (2 wt%), rubber (1%wt) others (<1 wt%).

Chemical state: Neutral

Chemical form of radionuclides: Ra: Small amounts of radium are present as radium sulphate

Metals and alloys (%wt): Sheet metal: 35% typical thickness 2 to 3 mm. Bulk items: 65%.

Stainless steel.....	<1.0	
Other ferrous metals.....	28.0	mild steel
Iron.....	28.0	cast iron cyclotron yokes
Aluminium.....	<1.0	
Beryllium.....	0	
Cobalt.....	0	
Copper.....	<3.0	cyclotron copper Dees
Lead.....	10.0	Shielding
Magnox/Magnesium.....	0	
Nickel.....	0	
Titanium.....	<1.0	size reduced Cs-137 boxes
Uranium.....	0	

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	Zinc.....	<1.0	
	Zircaloy/Zirconium.....	0	
	Other metals.....	1.0	Chromium
Organics (%wt):	The waste consists of about 26%wt organic material, plastics (22 wt%), cellulosics (2 wt%), rubber (1%wt).		
	Total cellulosics.....	2.0	
	Paper, cotton.....	~1.0	
	Wood.....	~1.0	
	Halogenated plastics	3.0	PVC, perspex
	Total non-halogenated plastics.....	19.0	
	Condensation polymers.....	18.0	fibreglass reinforced polyester
	Others.....	<0.90	Polyethylene
	Organic ion exchange materials....	0	
	Total rubber.....	<1.0	
	Halogenated rubber	<1.0	
	Non-halogenated rubber.....	<1.0	
	Hydrocarbons.....		
	Oil or grease		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	<0.90	
Other materials (%wt):	Others make up <1% of the stream.		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	0	
	Sand.....	0	
	Glass/Ceramics.....		
	Graphite.....	0	
	Desiccants/Catalysts.....	0	
	Asbestos.....	<0.10	
	Non/low friable.....	<0.05	
	Moderately friable.....	<0.05	
	Highly friable.....	<0.01	
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	There are <0.5% (probably <0.1%) inorganic anions present as surface contamination.		

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Fluoride.....	<0.10
Chloride.....	<0.10
Iodide.....	<0.10
Cyanide.....	0
Carbonate.....	<0.10
Nitrate.....	<0.10
Nitrite.....	0
Phosphate.....	<0.10
Sulphate.....	<0.10
Sulphide.....	<0.10

Materials of interest for waste acceptance criteria:

The waste contains no hazardous materials.

Combustible metals.....	0
Low flash point liquids.....	0
Explosive materials.....	0
Phosphorus.....	0
Hydrides.....	0
Biological etc. materials.....	0
Biodegradable materials.....	5.0
Putrescible wastes.....	0
Non-putrescible wastes.....	5.0
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Active particles.....	0
Soluble solids as bulk chemical compounds.....	0

paper cotton, wood.

Hazardous substances / non hazardous pollutants:

The waste contains lead.

Acrylamide.....	0
Benzene.....	0
Chlorinated solvents.....	0
Formaldehyde.....	0
Organometallics.....	0
Phenol.....	0
Styrene.....	0
Tri-butyl phosphate.....	0
Other organophosphates.....	0
Vinyl chloride.....	5.0
Arsenic.....	0
Barium.....	0
Boron.....	0

PVC

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Cadmium.....	0	
Caesium.....	0	
Selenium.....	0	
Chromium.....	0	
Molybdenum.....	0	
Thallium.....	0	
Tin.....	0	
Vanadium.....	0	
Mercury compounds.....	0	
Others.....	0	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	<1.0	~100 stripped down circuit boards
EEE Type 2.....	<1.0	~100
EEE Type 3.....	<1.0	~100
EEE Type 4.....		
EEE Type 5.....		
Complexing agents (%wt):	No	
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		The waste contains no complexing agents.
Total complexing agents.....	0	

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		100.0

Comment on planned treatments:

None

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Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	38.0
Expected to be consigned to a Landfill Facility	62.0
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:

Container	Stream volume %	Waste loading m ³	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	38.0	~15.6	18
2m box (no shielding)			
4m box (no shielding)			
Other (Not yet determined)			

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: NE

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste has a current WCH.
Inventory information is consistent with the current WCH.

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

Potential for the waste to contain discrete items: 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

WASTE STREAM**1A03****LLW Non-Compactable Non-Drummable**

Source:	This waste is generated as a result of decommissioning of facilities for manufacturing radio-pharmaceuticals and bio-science products. Radioactivity is present as low level contamination of general laboratory refuse and exists as a wide mixture of nuclides. The business mixture has changed and as a consequence fewer long lived nuclides are being generated.
Uncertainty:	Stock well understood - items measured and assessed.
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:	Radioactivity in waste is assessed by either direct measurement or from processing records, or in the case of activated components from samples and derived fingerprints aligned to dose with microshield modelling.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	5.83E-07	AA 1	~5.69E-06	AA 2	Gd 153				
Be 10					Ho 163				
C 14	1.11E-06	AA 1	~4.74E-05	AA 2	Ho 166m				
Na 22	1.56E-07	AA 1	~4.74E-07	AA 2	Tm 170				
Al 26			~9.49E-08	AA 2	Tm 171				
Cl 36			~3.8E-05	AA 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	3.77E-10	AA 1	~1.9E-06	AA 2	Pb 205				
Fe 55	2.82E-07	AA 1	~5.69E-04	AA 2	Pb 210	9.39E-08	AA 1	~1.01E-06	AA 2
Co 60	1.35E-05	AA 1	~1.42E-05	AA 2	Bi 208				
Ni 59					Bi 210m				
Ni 63	9.1E-06	AA 1	~4.74E-05	AA 2	Po 210	3.38E-14	AA 1	~1.01E-06	AA 2
Zn 65	1.82E-08	AA 1	~9.49E-07	AA 2	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	4.19E-09	AA 1	~1.19E-06	AA 2
Kr 85	9.09E-10	AA 1			Ra 228				
Rb 87					Ac 227				
Sr 90	4.53E-07	AA 1	~1.9E-05	AA 2	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			~9.49E-09	AA 2	U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m	1.01E-08	AA 1	~9.49E-09	AA 2	U 235				
Ag 110m			~9.49E-09	AA 2	U 236				
Cd 109			~9.49E-09	AA 2	U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238	1.38E-07	AA 1	~5.69E-08	AA 2
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125			~7.59E-06	AA 2	Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241	1.08E-05	AA 1	~9.49E-06	AA 2
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	5.42E-12	AA 1	~9.49E-09	AA 2	Cm 242				
Cs 135					Cm 243	6.38E-09	AA 1	~3.8E-09	AA 2
Cs 137	1.04E-04	AA 1	~1.94E-03	AA 2	Cm 244	2.98E-05	AA 1	~1.74E-05	AA 2
Ba 133	3.92E-08	AA 1	~9.49E-09	AA 2	Cm 245	4.01E-06	AA 1	~2.09E-06	AA 2
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147			~9.49E-09	AA 2	Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152	9.16E-08	AA 1	~9.49E-08	AA 2	Other b/g	1.75E-08	AA 1	~1.99E-07	AA 2
Eu 154		5	~9.49E-09	AA 2	Total a	4.47E-05	AA 1	~3.12E-05	AA 2
Eu 155					Total b/g	1.29E-04	AA 1	~2.69E-03	AA 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