

<b>WASTE STREAM</b>	<b>1A01</b>	<b>LLW Compactable Drummable</b>
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**SITE** Amersham  
**SITE OWNER** GE Healthcare Limited  
**WASTE CUSTODIAN** GE Healthcare Limited  
**WASTE TYPE** LLW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	31.8 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2030.....	75.0 m <sup>3</sup>
Total future arisings:		75.0 m <sup>3</sup>
Total waste volume:		106.8 m <sup>3</sup>

Comment on volumes: Stock and future waste arisings now only from decommissioning. Waste treatment: in-drum low force compaction only. Waste uncertainty factor is low due to understanding of operational waste volumes and predictions for decommissioning operations based on previous work.

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** This waste was generated as a result of manufacturing and developing radio-pharmaceuticals and bio-science products. Waste will arise in the future from decommissioning of these redundant facilities.

**PHYSICAL CHARACTERISTICS**

General description: General laboratory refuse and decayed manufacturing solid waste. The waste is subject to inspection, shredding and low force compaction within 200l drums. No items require special handling. The waste has undergone low force compaction.

Physical components (%wt): Metal (27wt%), soft organics (40 wt%), plastics/rubber (28wt%), glass (5 wt%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~0.5

Comment on density: The waste density is 0.5 t/m<sup>3</sup> after compaction.

**CHEMICAL COMPOSITION**

General description and components (%wt): The waste comprising mainly cellulose, plastics and rubber. Metal (27%), soft organics - paper / cotton wool / wood / cardboard (40%), PVC (14%), polyethylene (4%), polystyrene (5%), latex (5%), neoprene/hypalon (<1%), glass (5%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Organic - trace only  
 C-14: Organic - trace only  
 Cl-36: Trace quantity only  
 Tc-99: Trace quantity only - sodium pertechnetate  
 Ra: Radium sulphate - Trace only

Metals and alloys (%wt): ~100% of metal present is as sheet in form of mild steel drum. Typical thickness 1mm. Metal component of waste excluding drum <0.1%.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	<0.10		
Other ferrous metals.....	~26.1	Mild steel drum to BS1449 Part 1	
Iron.....			
Aluminium.....	<0.10		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	<0.20		

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Lead.....	0
Magnox/Magnesium.....	0
Nickel.....	0
Titanium.....	0
Uranium.....	0
Zinc.....	<0.10
Zircaloy/Zirconium.....	0
Other metals.....	<0.10

Organics (%wt):                      The waste contains cellulosic materials, plastics and rubber. Polyvinyl chloride.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	~40.0		
Paper, cotton.....	~39.0		
Wood.....	<1.0		
Halogenated plastics .....	~14.0	PVC sheeting / gaitors	
Total non-halogenated plastics.....	~9.0	Polyethylene / Polystyrene	
Condensation polymers.....	<0.10		
Others.....	~9.0		
Organic ion exchange materials....	0		
Total rubber.....	~5.0		
Halogenated rubber .....	<1.0	Hypalon/neoprene gloves/gaitors	
Non-halogenated rubber.....	5.0	Latex gloves	
Hydrocarbons.....			
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	<0.20		

Other materials (%wt):              Glass ~5%.

	(%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.....	5.0		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	<0.10		

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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):            The inorganic anion content is <0.5%, probably <0.1%.

	(%wt)	Type(s) and comment
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:            There are only very small quantities of hazardous materials in the waste.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	<0.01	
Biodegradable materials.....	~39.0	
Putrescible wastes.....	<0.01	
Non-putrescible wastes.....	39.0	39% Paper and cotton.
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:            There are no heavy metals present in the waste. Boron from borosilicate glass calculated using 10% of glass is borosilicate and the boron concentration is 8%.

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	0	

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Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	
Phenol.....	0	
Styrene.....	0	
Tri-butyl phosphate.....	0	
Other organophosphates.....	0	
Vinyl chloride.....	14.0	PVC plastic sheeting / bags / overshoes
Arsenic.....	0	
Barium.....	0	
Boron.....	0.04	
Boron (in Boral).....		
Boron (non-Boral).....	0.04	
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.....	0	
EEE Type 3.....	<1.0	<100 Various tooling from inside enclosures or used in decommissioning, any power tools (such as electric screwdrivers, drills, jigsaws) have batteries removed prior to use in the plant - they are adapted to use external power supply.
EEE Type 4.....	0	
EEE Type 5.....	0	
Complexing agents (%wt):	No	
	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		No complexing agents are present in this waste.
Total complexing agents.....	0	

Potential for the waste to contain discrete items: No.

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**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	On-site	100.0

Comment on planned treatments:

None

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	10.0	~0.50
Expected to be consigned to a Landfill Facility	90.0	~0.50
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		

Classification codes for waste expected to be consigned to a landfill facility: 20 01 01; 20 01 02; 20 01 38; 20 01 39; 20 01 40; 20 01 35\*; 16 02 13\*; 16 02 14

**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:**

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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	10.0	~15.6	< 1

Other information: Majority is being consigned as LALLW hence reduction in stream contribution to the repository

**Waste Planned for Disposal at the LLW Repository:**

Container voidage: Not yet determined

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.

**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: This waste was generated as a result of manufacturing radio-pharmaceuticals and bio-science products. The waste consists of general laboratory refuse collected in paper sacks, including clothing, plastics, light metal items and paper, and decayed waste from manufacturing enclosures including glassware, gloves and soft wastes. Similar waste will be generated from decommissioning of pharmaceutical manufacturing areas and redundant manufacturing areas for the production of radioactive sources and bio-science products. The waste is subject to on-site low force compaction within 200l drums. No items require special handling.

Uncertainty: All waste is measured individually by gamma spectroscopy using hyperpure germanium detectors, giving high confidence in declared activity.

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: All waste is measured individually by gamma spectroscopy using hyperpure germanium detectors, which are calibrated using traceable radioactive standards in reference drums. The process follows that in the NPL good practice guide number 34 "Radiometric non-destructive assay".

Other information: Total activity values represent the likely activity of waste arisings but nuclide breakdown depends upon commercial activity within a particular product sector. Activity estimates are derived from known levels of surface contamination, dose rate measurements and laboratory practice.

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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	1.88E-08	AA 2	~2.1E-07	AA 2	Gd 153				
Be 10					Ho 163				
C 14	6.09E-06	AA 2	~2E-07	AA 2	Ho 166m				
Na 22	8.56E-12	AA 1	~6.67E-08	AA 2	Tm 170				
Al 26					Tm 171				
Cl 36			~6.67E-08	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			~8E-08	AA 2	Pb 205				
Fe 55			~6.67E-08	AA 2	Pb 210		~6.67E-08	AA 2	
Co 60	3.15E-07	AA 1	~4E-07	AA 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			~6.67E-08	AA 2	Po 210	4.7E-28	AA 1	~6.67E-08	AA 2
Zn 65	3.65E-19	AA 1	~6.67E-08	AA 2	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226		~6.67E-08	AA 2	
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	6.39E-07	AA 1	~6.67E-07	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	3.14E-09	AA 2	~6.67E-08	AA 2	U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m			~6.67E-08	AA 2	U 235				
Ag 110m			~6.67E-08	AA 2	U 236				
Cd 109	8.33E-14	AA 1	~3.6E-07	AA 2	U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125			~6.67E-08	AA 2	Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241		~8E-07	AA 2	
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	3.57E-13	AA 1	~6.67E-08	AA 2	Cm 242				
Cs 135					Cm 243				
Cs 137	1.92E-02	AA 1	~2E-06	AA 2	Cm 244		~6.67E-08	AA 2	
Ba 133			~6.67E-08	AA 2	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			~6.67E-08	AA 2	Other b/g	4.7E-19	AA 2	~5.2E-07	AA 2
Eu 154			~6.67E-08	AA 2	<b>Total a</b>	<b>4.7E-28</b>	<b>AA 1</b>	<b>~1E-06</b>	<b>AA 2</b>
Eu 155					<b>Total b/g</b>	<b>1.92E-02</b>	<b>AA 1</b>	<b>~5.37E-06</b>	<b>AA 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