

WASTE STREAM	1A04	LLW Non-Compactable Drummable (Spoil)
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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.....	0 m ³
Future arisings -	1.4.2022 - 31.3.2030.....	~~1000.0 m ³
Total future arisings:		1000.0 m ³
Total waste volume:		1000.0 m ³
Comment on volumes:	Future volumes driven by cyclotron vault decommissioning. Forecast of ~600m ³ from remaining cyclotron vault demolition and ~400m ³ for remaining building demolition and land remediation. Volumes based on 2022 annual project review of concrete and spoil that will become LALLW. Volumes from cyclotron vault demolition have high confidence.	
Uncertainty factors on volumes:	Stock (upper): x 1.0	Arisings (upper) x 1.5
	Stock (lower): x 1.0	Arisings (lower) x 0.5

WASTE SOURCE Site strategy for decommissioning and demolition.

PHYSICAL CHARACTERISTICS

General description: The waste consists of large concrete blocks cut from the cyclotron vaults; soil, building foundations and drainage pipework contained in 200 l drums or 1 m³ bags.

Physical components (%wt): Concrete, building rubble (90 wt%); redundant drains, soil (7 wt%), mild steel drums (1 wt%), minor components (<2 wt%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 2

Comment on density: The density of the waste is 2 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Concrete, building rubble (including steel rebar) (90%), soil (7%), mild steel (1%), wood (<2%), polyethylene (<0.5%), perspex (<0.1%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Organic
C-14: Organic
Ra: Radium sulphate, radium bromide, radium carbonate

Metals and alloys (%wt): Metal is in the form of mild steel drums. Typical thickness - 1 mm.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	1.0	Mild steel	
Iron.....	0		
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....	0		

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Titanium.....	0
Uranium.....	0
Zinc.....	0
Zircaloy/Zirconium.....	0
Other metals.....	0

Organics (%wt): The waste contains some organic materials. Wood is present at <2%.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	<1.3		
Paper, cotton.....	0		
Wood.....	<1.3		
Halogenated plastics	0		
Total non-halogenated plastics.....	<0.60		
Condensation polymers.....	0		
Others.....	<0.60		
Organic ion exchange materials....	0		
Total rubber.....	<0.10		
Halogenated rubber	0		
Non-halogenated rubber.....	<0.10		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		

Other materials (%wt): Concrete / Soil / rubble / brick.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	~~7.0	soil and redundant drains	
Brick/Stone/Rubble.....	~~4.0	building rubble	
Cementitious material.....	86.0	concrete blocks	
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	TR		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			

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Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): Inorganic anions will be present in London clay (soil).

	(%wt)	Type(s) and comment
Fluoride.....	NE	
Chloride.....	NE	
Iodide.....	NE	
Cyanide.....	NE	
Carbonate.....	NE	
Nitrate.....	NE	
Nitrite.....	NE	
Phosphate.....	NE	
Sulphate.....	NE	
Sulphide.....	NE	

Materials of interest for waste acceptance criteria: There are no 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	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
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: None present

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	0	
Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	

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Phenol.....	0
Styrene.....	0
Tri-butyl phosphate.....	0
Other organophosphates.....	0
Vinyl chloride.....	0
Arsenic.....	0
Barium.....	0
Boron.....	0
Boron (in Boral).....	
Boron (non-Boral).....	
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.....	0
EEE Type 2.....	0
EEE Type 3.....	0
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.....		The waste contains no complexing agents.
Total complexing agents.....	0	

Potential for the waste to contain discrete items: Yes. Concrete blocks are discrete items

TREATMENT, PACKAGING AND DISPOSAL

WASTE STREAM

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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

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
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	100.0	2.0

Classification codes for waste expected to be consigned to a landfill facility: 17 05 04; 17 01 01; 17 01 02; 17 02 01

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: No

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

Waste Packaging for Disposal: (Not applicable to this waste stream)

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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			
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: Majority large concrete blocks (2.5t each)

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

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: -

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 activity from site decontamination work consists of Ra-226 and Cs-137. H3 and C14 production operations ceased approximately 21 years ago - plant and process wastes have been progressively dealt with since that time. Additional entries for the decommissioning of the cyclotron activated vault walls - based on measurement of core samples and application of fingerprints.

Uncertainty: Estimates based on review of decommissioning programmes and forecast.

Definition of total alpha and total beta/gamma: The total activity values are the sums of the listed alpha or beta/gamma emitting radionuclides.

Measurement of radioactivities: The radioactivity in this waste will be/has been assessed by sampling followed by direct measurement or in the case of activated concrete, sampling followed by the application of fingerprints, microshield modelling.

Other information: -

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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			~4.14E-05	AA 2	Gd 153				
Be 10					Ho 163				
C 14			~2.63E-09	AA 2	Ho 166m				
Na 22				5	Tm 170				
Al 26					Tm 171				
Cl 36			~2.63E-09	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			~2.31E-08	AA 2	Pb 205				
Fe 55			~5.17E-05	AA 2	Pb 210		~1.7E-05	AA 2	
Co 60			~3.35E-06	AA 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			~1.76E-07	AA 2	Po 210		~1.7E-05	AA 2	
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226		~1.92E-05	AA 2	
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90			~5.26E-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					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		~5.26E-09	AA 2	
Te 127m					Am 242m				
I 129					Am 243				
Cs 134			~2.81E-08	AA 2	Cm 242				
Cs 135					Cm 243				
Cs 137			~5.3E-05	AA 2	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			~1.58E-05	AA 2	Other b/g				
Eu 154			~1.1E-06	AA 2	Total a	0	3.62E-05	AA 2	
Eu 155			~2.8E-08	AA 2	Total b/g	0	1.84E-04	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