

WASTE STREAM**1A04****LLW Non-Compactable Drummable (Spoil)**

SITE Amersham
SITE OWNER GE Healthcare Limited
WASTE CUSTODIAN GE Healthcare Limited
WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	10.2 m ³
Future arisings -	1.4.2019 - 31.3.2030.....	~~1000.0 m ³
Total future arisings:		1000.0 m ³
Total waste volume:		1010.2 m ³

Comment on volumes: Increased volumes due to site strategy for decommissioning and demolition over next 5-10 years. Forecast of ~445m³ from remaining cyclotron vault demolition and ~555m³ for remaining building demolition and land remediation. Volumes based on initial estimates of concrete and spoil of buildings on the site strategy that will become predominantly LALLW and some LLW. 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 soil, building foundations and drainage pipework contained in 200 l drums or 1 m³ bags (LALLW). In some cases some packaged spoil may be loaded directly into a half height ISO container as approved for transport and emplacement at the LLWR. No items require special handling.

Physical components (%wt): Building rubble, redundant drains etc (45.5 wt%), soil (45.5 wt%), mild steel drums (5 wt%), minor components (<2 wt%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 1.6

Comment on density: The density of the waste is 1.6 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Building rubble including steel (45.5%), soil (45.5%), mild steel (5%), wood (<1.3%), 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.

Stainless steel.....	0	
Other ferrous metals.....	5.0	Mild steel
Iron.....	0	
Aluminium.....	0	
Beryllium.....	0	
Cobalt.....	0	
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	0	
Nickel.....	0	
Titanium.....	0	
Uranium.....	0	

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	Zinc.....	0
	Zircaloy/Zirconium.....	0
	Other metals.....	0
Organics (%wt):	The waste contains some organic materials. Wood is present at <2%.	
	Total cellulosics.....	<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):	Soil / rubble / brick.	
	Inorganic ion exchange materials.	0
	Inorganic sludges and flocs.....	0
	Soil.....	~~45.5
	Brick/Stone/Rubble.....	~~45.5
	Cementitious material.....	0
	Sand.....	1.0
	Glass/Ceramics.....	0
	Graphite.....	0
	Desiccants/Catalysts.....	1.0
	Asbestos.....	TR
	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	Inorganic anions will be present in London clay (soil).	

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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.

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
Active particles.....	0
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / non hazardous pollutants:

None present

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.....	0
Barium.....	0
Boron.....	0

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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..... 0
 EEE Type 2..... 0
 EEE Type 3..... 0
 EEE Type 4..... 0
 EEE Type 5..... 0

Complexing agents (%wt):

No
 EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

The waste contains no complexing agents.

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	2.0
Expected to be consigned to a Landfill Facility	98.0
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	2.0	~15.6	2
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: Majority predicted to be LALLW consigned in 1 m3 rubble bags.

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: No

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

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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 material in stock and 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 is 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 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	5.05E-05	AA 1	~4.90E-05	AA 2	Gd 153				
Be 10					Ho 163				
C 14	3.55E-07	AA 1	~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			~2.63E-07	AA 2	Pb 205				
Fe 55			~1.12E-04	AA 2	Pb 210	6.61E-09	AA 1	~1.69E-05	AA 2
Co 60	1.87E-10	AA 1	~4.97E-06	AA 2	Bi 208				
Ni 59					Bi 210m				
Ni 63	3.02E-05	AA 1	~1.80E-07	AA 2	Po 210	9.36E-15	AA 1	~1.69E-05	AA 2
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	1.01E-07	AA 1	~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	2.63E-07	AA 1	~5.26E-09	AA 2
Te 127m					Am 242m				
I 129					Am 243				
Cs 134			~7.71E-08	AA 2	Cm 242				
Cs 135					Cm 243				
Cs 137	2.12E-05	AA 1	~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	4.8E-09	AA 1	~1.86E-05	AA 2	Other b/g				
Eu 154			~1.43E-06	AA 2	Total a	3.64E-07	AA 1	3.62E-05	AA 2
Eu 155			~4.28E-08	AA 2	Total b/g	1.02E-04	AA 1	2.57E-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