WASTE STREAM 5C314 LETP Decommissioning LLW

SITE	Harwell
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	LLW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	155.8 m^3
Total future arisings:		0 m^3
Total waste volume:		155.8 m^3
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper): x 1.05 Stock (lower): x 0.95	Arisings (upper) x Arisings (lower) x

WASTE SOURCE The waste arisings from the LETP arise from 2 main project areas:- The Higher Level Area (HLA) generating primarily LLW and soft waste from decommissioning - The Medium Level and Low Activity area generating VLLW from removal of buildings and structures.

PHYSICAL CHARACTERISTICS

General description:	Building rubble, concrete, metal and organic material from the decommissioning of buildings, tanks, over-ground and underground structures at the LETP.
Physical components (%wt):	Metal (36%), concrete/building rubble (19%), Soil (13%), biodegradables (3%), plasterboard (1%), plastics (15%), rubber (2%), wood (2%), other organic (3%), others (6%) including asbestos and glass
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m^3):	~0.93
Comment on density:	Taken from WCH mass divided by volume

CHEMICAL COMPOSITION

General description and components (%wt):	Metal (36%), concrete/building rubble (19%), Soil (13%), biodegradables (3%), plasterboard (1%), plastics (15%), rubber (2%), wood (2%), other organic (3%), others (6%) including asbestos and glass
Chemical state:	Neutral
Chemical form of radionuclides:	Ra: Present as a decay product of fuel. U: Present as a metal or an oxide. Pu: Present as metal, oxide or nitrate
Metals and alloys (%wt):	-

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~15.1	Plate pieces/pipework/ HEPA filter cases	
Other ferrous metals.....	~15.5	Mild steel - Drums, tank pieces, pipework	
Iron.....	~4.2	Plant, equipment, tank pieces, pipework	
Aluminium.....	~0.01	Vent work. Ladders. Tooling	
Beryllium.....			
Cobalt.....			
Copper.....	~0.01	Alloy in metals	
Lead.....	~1.0	Shielding materials	

Magnox/Magnesium	TR	Steel and grout
Nickel	~0.01	Alloy in metals
Titanium	TR	Alloy in metals
Uranium		
Zinc	~0.04	Alloy in metals / galvanised metals
Zircaloy/Zirconium	TR	
Other metals	TR	Trace amounts of uranium metal may be present.

Organics (%wt): The halogenated plastics present are PVC and PTFE. The halogenated rubbers present are hypalon and neoprene.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	2.0		
Paper, cotton	0		
Wood	2.0		
Halogenated plastics	2.0	Soft waste / PPE / Wrapping PVC and PTFE	
Total non-halogenated plastics	13.0		
Condensation polymers	~0		
Others	~13.0	Soft waste / PPE / Wrapping	
Organic ion exchange materials			
Total rubber	~2.0		
Halogenated rubber	~1.0	Hypalon and neoprene	
Non-halogenated rubber	~1.0		
Hydrocarbons	~3.1		
Oil or grease			
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen	~3.1	Tank bund liners	
Others			
Other organics	3.0	Undefined	

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	NE		
Inorganic sludges and flocs	NE		
Soil	13.0		
Brick/Stone/Rubble	~19.0		
Cementitious material			
Sand			
Glass/Ceramics	~5.0	Mylar and glass. Glass reinforced plastic (GRP) from removal of the HLA tanks	
Graphite	0		
Desiccants/Catalysts			

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Asbestos.....	0.46	
Non/low friable.....	~0.46	Building cladding (bound) chrysotile (white)
Moderately friable.....	0	
Highly friable.....	0	
Free aqueous liquids.....	0	
Free non-aqueous liquids.....	0	
Powder/Ash.....	0	

Inorganic anions (%wt): Carbonates present in concrete.

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	0	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	P	
Nitrate.....	0	
Nitrite.....	0	
Phosphate.....	TR	Grout
Sulphate.....	0	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: Trace amounts of uranium metal may be present.

	(%wt)	Type(s) and comment
Combustible metals.....	TR	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	~3.0	
Putrescible wastes.....	~1.0	Organics; leaves/foliage
Non-putrescible wastes.....	~2.0	
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	P	50m2
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

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Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....		
Caesium.....		
Selenium.....		
Chromium.....	~0.01	Alloy in metals
Molybdenum.....	TR	Alloy in metals
Thallium.....		
Tin.....	~0.02	Alloy in metals
Vanadium.....	TR	Alloy in metals
Mercury compounds.....		
Others.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	P	10 off Stripped down circuit boards
EEE Type 2.....	P	10 off Wiring and removal of Electronic Control Unit from grouting plant, small components from Brokk.
EEE Type 3.....	P	40 off Corded power tools; drills, reciprocating saws
EEE Type 4.....		
EEE Type 5.....		

Complexing agents (%wt):

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....		

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Total complexing agents..... NE

Potential for the waste to contain discrete items: Not yet determined. Large Concrete Items (LCIs) may be DIs; drummed (ungrouted)/"rubbleised" wastes assumed not DIsLarge Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIsSoil - In & of itself not a DI

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)	Off-site	~~1.9
Incineration	Off-site	~~4.3
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		~~93.8

Comment on planned treatments: 86.29% of this stream is expected to be disposed to landfill

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	9.4	0.93
Expected to be consigned to a Landfill Facility	86.3	0.93
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	4.3	0.40
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: 17 04 07, 17 05 03*/04, 17 02 02, 17 06 01*, 17 02 03

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
-	-	-	-	-	-

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Waste Packaging for Disposal:

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	1.9	21.6	< 1
1/2 Height IP-2 Disposal/Re-usable ISO	7.5	10	2
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: 21.6m3 is calculated based on the fact that ordinarily you can fit 36 (200 litre/0.2m3) drums (7.2m3) into a ½ height ISO, each drum can be squashed to a 1/3 of its original volume so therefore we can get 3 x the amount of un-compacted drums into the final disposal container (21.6m3).

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

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: 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

Source: Activity in waste has arisen from the treatment of liquid effluent.

Uncertainty: -

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: Rad data taken from WCH - 1MXN-2HAR-0-WCH-0-4596 V5 and decayed 4 years for RWI 2022

Other information: -

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	4.15E-06	C C 1			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	6.24E-06	C C 1			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	2.01E-08	C C 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40	2.64E-08	C C 2			Hf 182		8		
Ca 41		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	6.42E-08	C C 1			Pb 210	7.78E-08	C C 2		
Co 60	6.92E-08	C C 1			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63	8.99E-07	C C 1			Po 210	6.76E-08	C C 2		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226	6.75E-07	C C 2		
Kr 85		8			Ra 228	2.17E-07	8		
Rb 87		8			Ac 227		8		
Sr 90	4.98E-05	C C 1			Th 227		8		
Zr 93		8			Th 228	1.09E-07	C C 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m		8			Th 232	5.67E-07	C C 2		
Nb 94	3.01E-09	C C 2			Th 234	1.75E-06	8		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	1.75E-06	C C 2		
Ag 108m		8			U 235	8.16E-08	C C 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	1.75E-06	C C 2		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	1.50E-05	C C 2		
Sn 123		8			Pu 239	1.35E-05	C C 2		
Sn 126		8			Pu 240	6.66E-06	C C 2		
Sb 125	2.23E-09	C C 2			Pu 241	1.18E-05	C C 1		
Sb 126		8			Pu 242	7.75E-09	C C 2		
Te 125m		8			Am 241	1.54E-05	C C 2		
Te 127m		8			Am 242m		8		
I 129	3.06E-09	C C 2			Am 243		8		
Cs 134		8			Cm 242	6.38E-09	C C 2		
Cs 135		8			Cm 243	3.95E-06	C C 2		
Cs 137	3.99E-05	C C 2			Cm 244	3.72E-06	C C 2		
Ba 133		8			Cm 245	9.67E-09	C C 2		
La 137		8			Cm 246	9.67E-09	C C 2		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147		8			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		8			Other a				
Eu 152	6.01E-08	C C 2			Other b/g				
Eu 154	4.24E-08	C C 2			**Total a**	**6.33E-05**	**C C 2**	**0**	
Eu 155	5.21E-08	C C 2			**Total b/g**	**1.15E-04**	**C C 2**	**0**	

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