WASTE STREAM 5C303 Radiochemical Laboratory Decommissioning LLW

SITE	Harwell
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	236.2 m³
Future arisings -	1.4.2019 - 31.3.2025.....	708.8 m³
Total future arisings:		708.8 m³
Total waste volume:		945.0 m³

Comment on volumes: Volumes updated for 2016 RWI to reflect SMART Inventory Review. This stream originally included VLLW/LA-LLW but this is now included under stream 5C325.

Uncertainty factors on volumes:				
	Stock (upper):	x 1.3	Arisings (upper)	x 1.3
	Stock (lower):	x 0.7	Arisings (lower)	x 0.7

WASTE SOURCE Radiochemistry laboratory decommissioning waste.

PHYSICAL CHARACTERISTICS

General description: Material development and examination laboratory. Miscellaneous items from decommissioning of cells, gloveboxes, ventilation systems and pipework. Large items, e.g. gloveboxes, are size reduced for consignment as waste. Waste volumes will be minimised by a number of techniques (size reduction, segregation, packing efficiency, compaction of soft wastes, etc.).

Physical components (%vol): Steel (63%), Plastic (10%), Perspex (8%), Bakelite (5%), Lead (5%), Rubber (4%), Paper (2%), Cotton (1%), Glass (1%) and Wood (1%).This is a typical volume % breakdown but will vary according to the decommissioning process employed. Painted-in radioactivity and heavily contaminated structures will generate materials such as contaminated plaster and concrete.

Sealed sources: -

Bulk density (t/m³): ~3

Comment on density: The density of the waste stream varies between 0.6 and 11.3 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Steel (80.9%), lead (9%), perspex (2%), plastic (2%), bakelite (1%), rubber (1%), wood (0.25%), paper (0.5%) cotton(0.5%) glass (0.5%).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Unknown
C-14: C-14 is associated with organic compounds.
Cl-36: Unknown
Tc-99: Unknown
I-129: Unknown
Ra: Unknown
Th: The chemical form of thorium is unknown but probably comprises of mainly oxide with small amounts of nitrates.
U: The chemical form of uranium is unknown but probably comprises mainly oxide and metal with small amounts of nitrates.
Np: The chemical form of neptunium is unknown but will probably be present mainly in oxide or nitrate form.
Pu: The chemical form of plutonium is unknown but probably comprises of mainly oxide with small amounts of nitrates.

Metals and alloys (%wt): Metal is present in a large range of thicknesses.

	Stainless steel	P	
	Other ferrous metals	80.9	The grades of steel have not been determined.
	Iron		
	Aluminium	<1.0	
	Beryllium		
	Cobalt		
	Copper	<0.40	
	Lead	9.0	
	Magnox/Magnesium	TR	
	Nickel		
	Titanium		
	Uranium		
	Zinc	0	
	Zircaloy/Zirconium	TR	
	Other metals	TR	Other metals include uranium.
Organics (%wt):	Cellulosics include wood, cotton and paper. The total plastics content is about 4%. Halogenated plastics are PVC and PTFE, and rubbers are hypalon and neoprene. Condensation polymers are bakelite and others are perspex.		
	Total cellulosics	<1.3	
	Paper, cotton	<1.0	
	Wood	<0.25	
	Halogenated plastics	2.0	PVC and PTFE
	Total non-halogenated plastics	3.0	
	Condensation polymers	2.0	Bakelite
	Others	1.0	Perspex
	Organic ion exchange materials	0	
	Total rubber	1.0	
	Halogenated rubber	1.0	Hypalon and neoprene
	Non-halogenated rubber	NE	
	Hydrocarbons		
	Oil or grease		
	Fuel		
	Asphalt/Tarmac (cont.coal tar)		
	Asphalt/Tarmac (no coal tar)		
	Bitumen		
	Others		
	Other organics	NE	
Other materials (%wt):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs	0	
	Soil	0	
	Brick/Stone/Rubble	0	
	Cementitious material	0	

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	Sand	
	Glass/Ceramics	<0.50
	Graphite	0
	Desiccants/Catalysts	
	Asbestos	NE
	Non/low friable	
	Moderately friable	
	Highly friable	
	Free aqueous liquids	0
	Free non-aqueous liquids	TR
	Powder/Ash	0
Inorganic anions (%wt):	None present.	
	Fluoride	0
	Chloride	0
	Iodide	0
	Cyanide	0
	Carbonate	0
	Nitrate	0
	Nitrite	0
	Phosphate	0
	Sulphate	0
	Sulphide	0
Materials of interest for waste acceptance criteria:	Asbestos may be present as pipe lagging. Combustible metals comprise uranium.	
	Combustible metals	TR
	Low flash point liquids	0
	Explosive materials	0
	Phosphorus	0
	Hydrides	0
	Biological etc. materials	0
	Biodegradable materials	
	Putrescible wastes	0
	Non-putrescible wastes	
	Corrosive materials	0
	Pyrophoric materials	0
	Generating toxic gases	0
	Reacting with water	0
	Active particles	
	Soluble solids as bulk chemical compounds	

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Hazardous substances / non hazardous pollutants: Lead is present as metal. Antimony and cadmium may be present and asbestos is likely to be present in the waste.

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

Boron.....

Cadmium.....

Caesium.....

Selenium.....

Chromium.....

Molybdenum.....

Thallium.....

Tin.....

Vanadium.....

Mercury compounds.....

Others.....

Electronic Electrical Equipment (EEE)

EEE Type 1.....

EEE Type 2.....

EEE Type 3.....

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt): Yes

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... TR

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration	Off-site	~61.0
Solidification		
Decontamination		
Metal treatment	Off-site	~21.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		18.0

Comment on planned treatments: -

Disposal Routes:

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	18.0
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	61.0
Expected to be consigned to a Metal Treatment Facility	21.0
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	18.0	10	18
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: <10%

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste does not have a current WCH.

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WSCD only covers part of the waste stream.

Waste consigned for disposal to LLWR in year of generation:	-
Potential for the waste to contain discrete items:	-

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:	Contamination from wide range of historic operations. Some additional contamination will be introduced from planned waste management operations.
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:	Individual fingerprints for each facility created from combination of measurements and assessment/ modelling. These have been combined to provide an overall estimate of future arisings, based on past experience.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	3.17E-09	B C 2	3.17E-09	B C 2	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14		8		8	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36	3.4E-09	B B 2	3.4E-09	B B 2	Lu 174		8		8
Ar 39		8		8	Lu 176		8		8
Ar 42		8		8	Hf 178n		8		8
K 40		8		8	Hf 182		8		8
Ca 41		8		8	Pt 193		8		8
Mn 53		8		8	Tl 204		8		8
Mn 54		8		8	Pb 205		8		8
Fe 55	1.35E-07	B C 2	1.35E-07	B C 2	Pb 210	1.38E-08	B B 2	1.38E-08	B B 2
Co 60	4.64E-09	B C 2	4.64E-09	B C 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	2.14E-06	B B 2	2.14E-06	B B 2	Po 210	1.37E-08	B B 2	1.37E-08	B B 2
Zn 65		8		8	Ra 223		8		8
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226	1.55E-08	B B 2	1.55E-08	B B 2
Kr 85	4.87E-08	B B 2	4.87E-08	B B 2	Ra 228	1.63E-08	B B 2	1.63E-08	B B 2
Rb 87		8		8	Ac 227		8		8
Sr 90	2.62E-04	B B 2	2.62E-04	B B 2	Th 227		8		8
Zr 93		8		8	Th 228	1.27E-08	B B 2	1.27E-08	B B 2
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230		8		8
Nb 93m		8		8	Th 232	2.47E-08	B B 2	2.47E-08	B B 2
Nb 94		8		8	Th 234	8.32E-09	B B 2	8.32E-09	B B 2
Mo 93		8		8	Pa 231		8		8
Tc 97		8		8	Pa 233		8		8
Tc 99	5.53E-09	B B 2	5.53E-09	B B 2	U 232		8		8
Ru 106		8		8	U 233		8		8
Pd 107		8		8	U 234	3.68E-08	B B 2	3.68E-08	B B 2
Ag 108m		8		8	U 235	1.23E-09	B B 2	1.23E-09	B B 2
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238	8.32E-09	B B 2	8.32E-09	B B 2
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	1.57E-04	B B 2	1.57E-04	B B 2
Sn 123		8		8	Pu 239	2.63E-04	B B 2	2.63E-04	B B 2
Sn 126		8		8	Pu 240	2.04E-04	B B 2	2.04E-04	B B 2
Sb 125		8		8	Pu 241	7.13E-03	B B 2	7.13E-03	B B 2
Sb 126		8		8	Pu 242	1.03E-07	B B 2	1.03E-07	B B 2
Te 125m		8		8	Am 241	5.57E-04	B B 2	5.57E-04	B B 2
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134		8		8	Cm 242		8		8
Cs 135		8		8	Cm 243		8		8
Cs 137	2.17E-06	B C 2	2.17E-06	B C 2	Cm 244	3.25E-08	B B 2	3.25E-08	B B 2
Ba 133		8		8	Cm 245		8		8
La 137		8		8	Cm 246		8		8
La 138		8		8	Cm 248		8		8
Ce 144		8		8	Cf 249		8		8
Pm 145		8		8	Cf 250		8		8
Pm 147	1.58E-09	B B 2	1.58E-09	B B 2	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151	5.23E-09	B B 2	5.23E-09	B B 2	Other a				
Eu 152		8		8	Other b/g				
Eu 154	1.19E-08	B B 2	1.19E-08	B B 2	**Total a**	**1.18E-03**	**B B 2**	**1.18E-03**	**B B 2**
Eu 155	1.41E-09	B B 2	1.41E-09	B B 2	**Total b/g**	**7.40E-03**	**B B 2**	**7.40E-03**	**B B 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