

WASTE STREAM	5C303	Radiochemical Laboratory Decommissioning LLW
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SITE Harwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE LLW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025	= 201.1		
Future arisings:	1.4.2029 - 31.3.2053	678.9		
Total future arisings:		678.9		
Total waste volume:		880.0		

Number of waste packages in stock: At 1.4.2025..... - packages

Comment on arising rates: -

Additional information on quantities: 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 1.30	Arisings (upper):	x 1.30
Stock (lower):	x 0.70	Arisings (lower):	x 0.70

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.

Changes since waste generated: Waste volumes will be minimised by a number of techniques (size reduction, segregation, packing efficiency, compaction of soft wastes, etc.).

Bulk density (t/m³): ~ 3.0

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): Concrete/brick/plaster (65.6%), bitumen (0.7%), AIB/ACM/MMMF (0.1%), Fibreboard (0.5%), wood (1%), Metals (29.5%), glass (0.07%), hard plastics (1.9%), ceramic (0.03%), lino (0.06%).

Chemical state: Neutral

Sheet metal proportion / thickness: Metal is present in a large range of thicknesses.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	-	-	
Other ferrous metals.....	-	-	
Iron.....	-	-	
Aluminium.....	-	-	
Beryllium.....	-	-	
Cobalt.....	-	-	
Copper.....	-	-	
Lead.....	-	-	
Magnox/Magnesium.....	-	-	
Nickel.....	-	-	
Titanium.....	-	-	
Uranium.....	-	-	
Zinc.....	-	-	
Zircaloy/Zirconium.....	-	-	
Other metals.....	= 29.5	Metal type has not been determined	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 1.0	-	
Paper, cotton.....		-	
Wood.....	= 1.0	-	
Halogenated plastics.....	= 1.0	PVC and PTFE	
Total non-halogenated plastics.....	= 0.90	-	
Condensation polymers.....	= 0.50	bakelite	
Others.....	= 0.40	perspex	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	NE	-	
Halogenated rubber.....	NE	-	
Non-halogenated rubber.....	NE	-	
Hydrocarbons.....	= 0.70	-	
Oil or grease.....		-	
Fuel.....		-	
Asphalt/Tarmac (cont.coal tar).....		-	
Asphalt/Tarmac (no coal tar).....		-	
Bitumen.....	= 0.70	-	
Others.....		-	
Other organics.....	NE	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 0	-	
Inorganic sludges and flocs.....	= 0.60	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 65.6	-	
Cementitious material.....	= 0	-	
Sand.....		-	
Glass/Ceramics.....	= 0.10	0.03% ceramic, 0.07% glass	
Graphite.....	= 0	-	
Desiccants/Catalysts.....		-	
Asbestos.....	~ 0.10	-	
Non/low friable.....	~ 0.10	-	
Moderately friable.....		-	
Highly friable.....		-	
Free aqueous liquids.....	= 0	-	
Free non-aqueous liquids.....	TR	-	
Powder/Ash.....	= 0	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
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:

	(%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.....	0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....		-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	= 0	-
Higher activity particles.....		-
Soluble solids as bulk chemical compounds.....		-

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	0	-
Benzene.....		-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....		-
Phenol.....		-
Styrene.....		-
Tri-butyl phosphate.....		-
Other organophosphates.....		-
Vinyl chloride.....		-
Arsenic.....		-
Barium.....		-
Boron.....		-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....		-
Caesium.....		-
Selenium.....		-
Chromium.....		-
Molybdenum.....		-
Thallium.....		-
Tin.....		-
Vanadium.....		-
Mercury compounds.....		-
Others.....		-

Complexing agents (%wt):

Yes		
	(%wt)	Type(s) and comment
EDTA.....	TR	-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....		-
Other organic complexants.....		-
Total complexing agents.....		-

Physical components:

	Number	Type(s) and comment
Sources.....		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1.....		-
EEE Type 2.....		-
EEE Type 3.....		-
EEE Type 4.....		-
EEE Type 5.....		-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction	Off-site	~ 5.0
Decay storage		
Low force compaction		
Supercompaction (HFC)	Off-site	~ 5.0
Incineration	Off-site	~ 18.0
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application		
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		~ 1.0
Polymer encapsulation		
Other physical treatment		= 71.0
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		

Comments on planned treatments:

Conditioning method:

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

Further information on the conditioning matrix:

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	1/2 Height WAMAC IP-2 ISO (TC08)	5.0	21.6	18.8	3	-
	1/2 Height IP-2 Disposal/Re-usable ISO (TC01/TC02)	40.0	10.0	18.3	36	-

Range in container waste loading: -

Other information on packaging and conditioning: -

Conditioned density (t/m³): -
Conditioned density comment: -**Management Routes:**

Disposal Route	Stream volume %	Raw density t/m³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)			
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository	= 45.0	3.0	
Expected to be consigned to a Landfill Facility	= 32.0	3.0	
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility	= 5.0	0.40	
Expected to be consigned to a Metal Treatment Facility	= 18.0	1.4	
Expected to be 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 06 04, 17 02 01, 17 02 02, 17 02 03, 17 01 07, 17 06 01*

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: Contamination from wide range of historic operations. Some additional contamination will be introduced from planned waste management operations.

Uncertainty: -

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.

Chemical form of radionuclides:

H-3: Unknown
C-14: C-14 is associated with organic compounds.
Cl-36: Unknown
Se-79: -
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.

WASTE STREAM 5C303 Radiochemical Laboratory Decommissioning LLW									
Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	= 2.26E-09	B C 2	= 1.81E-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	= 3.40E-09	B B 2	= 3.40E-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	Ti 204		8		8
Mn 54		8		8	Pb 205		8		8
Fe 55	= 2.95E-08	B C 2	= 1.07E-08	B C 2	Pb 210	= 1.40E-08	B B 2	= 1.42E-08	B B 2
Co 60	= 2.11E-09	B C 2	= 1.25E-09	B C 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	= 2.06E-06	B B 2	= 2.00E-06	B B 2	Po 210	= 1.40E-08	B B 2	= 1.42E-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	= 3.30E-08	B B 2	= 2.55E-08	B B 2	Ra 228	= 2.07E-08	B B 2	= 2.22E-08	B B 2
Rb 87		8		8	Ac 227		8		8
Sr 90	= 2.27E-04	B B 2	= 2.06E-04	B B 2	Th 227		8		8
Zr 93		8		8	Th 228	= 1.87E-08	B B 2	= 2.10E-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	1.37E-09	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	= 3.94E-08	B B 2	= 4.10E-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	1.39E-09	8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	= 1.49E-04	B B 2	= 1.45E-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	= 5.34E-03	B B 2	= 4.41E-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	= 6.11E-04	B B 2	= 6.38E-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	= 1.90E-06	B C 2	= 1.73E-06	B C 2	Cm 244	= 2.59E-08	B B 2	= 2.22E-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		8		8	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151	= 4.99E-09	B B 2	= 4.84E-09	B B 2	Unsp a				
Eu 152		8		8	Unsp b/g				
Eu 154	= 7.33E-09	B B 2	= 5.31E-09	B B 2	Total a	1.23E-03	*	1.25E-03	*
Eu 155		8		8	Total b/g	5.57E-03	*	4.62E-03	*

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 the 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
* Total calculated from the 114 declared radionuclides