

WASTE STREAM	5C318	Harwell Remote Handled ILW - WRATs
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SITE Harwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025	= 11.6		
Future arisings:				
Total future arisings:		0.0		
Total waste volume:		11.6		

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

Comment on arising rates: Waste retrieved under waste stream ID 5C30 that requires further treatment is included in the volume above.

Additional information on quantities: This waste stream represents ILW that has been retrieved from storage tubes under stream 5C30 and is now stored in 500 litre drums awaiting further work prior to grouting. These are known as Waste Requiring Additional Treatment (WRATs). The volume given is the volume of waste cans, not the outer 500 litre drums.

Uncertainty factors on volumes:

Stock (upper):	x 1.05	Arisings (upper):	x -
Stock (lower):	x 0.95	Arisings (lower):	x -

WASTE SOURCE Operational solid wastes from research reactors and active cells performing a wide variety of tasks, including fuel examination, source production and others. Redundant sources, notably Co60, Am/Be and Pu238.

PHYSICAL CHARACTERISTICS

General description: Laboratory/ cell wastes, sources, cut-up experimental rigs, glassware and concrete. Most wastes in cans (max 50 litres).

Changes since waste generated: Some wastes (including liquids) have been cemented or encapsulated in polymer. Some solids have been subject to low-force compaction.

Bulk density (t/m³): ~ 0.80

Comment on density: Estimate- mass data not available for many items.

CHEMICAL COMPOSITION

General description and components (%wt): Ferrous metal (>21%), other metals (<38%), plastics (<16%), cellulose(<12%) and others. Note that this does not include the steel containers, most of which are diverted to LLW.

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.....	P	-	
Other ferrous metals.....	~ 21.0	The identity of steels/other alloys is unknown.	
Iron.....	-	-	
Aluminium.....	~ 33.0	-	
Beryllium.....	= 0	-	
Cobalt.....	-	-	
Copper.....	~ 0.40	-	
Lead.....	~ 0.60	-	
Magnox/Magnesium.....	TR	-	
Nickel.....	-	-	
Titanium.....	-	-	
Uranium.....	< 0.01	-	
Zinc.....	TR	-	
Zircaloy/Zirconium.....	~ 0.50	-	
Other metals.....	~ 4.0	Other metals include uranium, europium, cobalt, magnesium, tin, nickel and trace mercury.	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~ 12.0	-	
Paper, cotton.....	~ 11.8	-	
Wood.....	~ 0.20	-	
Halogenated plastics.....	< 13.0	PVC and PTFE	
Total non-halogenated plastics.....	< 9.9	-	
Condensation polymers.....	~ 0.40	-	
Others.....	< 9.5	-	
Organic ion exchange materials.....	~ 0.03	-	
Total rubber.....	< 0.50	-	
Halogenated rubber.....	< 0.25	neoprene and hypalon	
Non-halogenated rubber.....	< 0.25	-	
Hydrocarbons.....	-	-	
Oil or grease.....	-	-	
Fuel.....	-	-	
Asphalt/Tarmac (cont.coal tar).....	-	-	
Asphalt/Tarmac (no coal tar).....	-	-	
Bitumen.....	-	-	
Others.....	-	-	
Other organics.....	< 0.10	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	P	-	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	~ 2.0	-	
Sand.....	-	-	
Glass/Ceramics.....	~ 1.5	-	
Graphite.....	~ 0.10	-	
Desiccants/Catalysts.....	-	-	
Asbestos.....	~ 0	Exact data unavailable	
Non/low friable.....	-	-	
Moderately friable.....	-	-	
Highly friable.....	-	-	
Free aqueous liquids.....	< 0.01	-	
Free non-aqueous liquids.....	< 0.01	-	
Powder/Ash.....	P	-	

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	< 0.01	-
Chloride.....	< 1.0	-
Iodide.....	< 0.01	-
Cyanide.....	NE	-
Carbonate.....	< 0.10	-
Nitrate.....	< 0.10	-
Nitrite.....	< 0.10	-
Phosphate.....	< 0.10	-
Sulphate.....	< 0.10	-
Sulphide.....	< 0.10	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	< 0.10	-
Low flash point liquids.....	< 0.01	-
Explosive materials.....	< 0.01	-
Phosphorus.....	< 0.01	-
Hydrides.....	< 0.01	-
Biological etc. materials.....	< 0.01	-
Biodegradable materials.....	0.01	-
Putrescible wastes.....	< 0.01	-
Non-putrescible wastes.....	-	-
Corrosive materials.....	< 0.01	-
Pyrophoric materials.....	< 0.01	-
Generating toxic gases.....	< 0.01	-
Reacting with water.....	< 0.01	-
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.....		Unknown
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 Decay storage Low force compaction Supercompaction (HFC) Incineration Drying/dewatering/liquid separation Tie down/fixatives/strippable coating/painting application Decontamination Metal treatment Recycling / reuse Thermal treatment, including vitrification Encapsulation Polymer encapsulation Other physical treatment Other chemical treatment Containerisation Treatment not yet determined None	On-site	100.0

Comments on planned treatments:

-

Conditioning method:

See 5C52 for details of conditioning plant. The waste is removed from its storage cans and treated prior to packaging into enhanced 500 litre drums. At this point it is reclassified as 5C52 and stored pending availability of the conditioning plant. A proportion of the waste stream, including the cans, may be reclassified as CHILW/ LLW and processed accordingly.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

Unknown

Further information on the conditioning matrix:

3:1 PFA:OPC w/s 0.42.

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	500 l drum (pre-cast annular)	100.0	0.40	0.40	29	-

Range in container waste loading: Significant variation in waste loading is expected, based upon the precise nature of the wastes being packaged at any time, and limits applying to their contents.

Other information on packaging and conditioning: -

Conditioned density (t/m³): ~ 2.0

Conditioned density comment: Density will vary according to nature of individual drum contents.

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)	100.0		
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			
Expected to be consigned to a Landfill Facility			
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
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:

Opportunities for alternative disposal routing: No

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

RADIOACTIVITY

Source: Activated and contaminated items from historic R&D activities on the Harwell site, including standard sources and fuel samples.

Uncertainty: -

Measurement of radioactivities: Variety of techniques according to waste type/ source and time of consignment. Typically based on gamma dose measurements and/ or fuel/ item masses where appropriate.

Chemical form of radionuclides: H-3: H3 is principally present as a metal activation product with some absorption from D2O/H3 gas
C-14: C-14 is associated with labelled organic compounds and activation of metals
Cl-36: -
Se-79: -
Tc-99: -
I-129: -
Ra: Radium may be present in a variety of forms, principally oxide, nitrate and sulphate.
Th: Thorium is principally present as metal or oxide and in irradiated fuel.
U: Uranium may be present in a variety of forms, principally oxide, metal and fuel.
Np: -
Pu: Plutonium may be present in a variety of forms, principally oxide and metal fuel.

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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	6.57E-01	C C 2			Gd 153	1.52E-06	B B 2		
Be 10		8			Ho 163		8		
C 14	3.53E-05	C C 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	4.25E-05	B B 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40	1.31E-05	B C 2			Hf 182		8		
Ca 41	3.84E-06	B B 2			Pt 193		8		
Mn 53		8			Ti 204		8		
Mn 54		8			Pb 205		8		
Fe 55	4.76E-04	B B 2			Pb 210	8.24E-05	B C 2		
Co 60	3.83E+00	B B 2			Bi 208		8		
Ni 59	1.46E-02	B B 2			Bi 210m		8		
Ni 63	9.86E-01	B B 2			Po 210	8.39E-05	C C 2		
Zn 65		8			Ra 223	1.37E-02	C C 2		
Se 79		6			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85	4.39E-03	B B 2			Ra 228		8		
Rb 87		8			Ac 227	1.36E-02	C C 2		
Sr 90		8			Th 227	1.35E-02	C C 2		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	2.40E-04	B B 2			Th 232		8		
Nb 94	3.57E-04	B B 2			Th 234		8		
Mo 93	9.19E-05	B C 2			Pa 231	2.87E-05	B C 2		
Tc 97		8			Pa 233	7.70E-06	C C 2		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		6			U 234	2.05E-06	C C 2		
Ag 108m	6.03E-04	B B 2			U 235		8		
Ag 110m		8			U 236	2.60E-08	C C 2		
Cd 109	6.19E-09	B B 2			U 238		8		
Cd 113m	1.52E-02	B B 2			Np 237	7.71E-06	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	5.79E-02	C C 2		
Sn 123		8			Pu 239	1.10E-01	C C 2		
Sn 126		8			Pu 240	7.31E-02	C C 2		
Sb 125		8			Pu 241	1.79E+00	C C 2		
Sb 126		8			Pu 242	8.99E-05	C C 2		
Te 125m		8			Am 241	2.95E-01	C C 2		
Te 127m		8			Am 242m	2.93E-07	B C 2		
I 129	2.54E-06	B B 2			Am 243	1.82E-04	C C 2		
Cs 134	5.22E-06	B B 2			Cm 242	2.42E-07	C C 2		
Cs 135	4.25E-07	B C 2			Cm 243	1.10E-07	C C 2		
Cs 137	4.70E+00	B B 2			Cm 244	3.03E-02	C C 2		
Ba 133	7.96E-06	B B 2			Cm 245	3.25E-09	B C 2		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	5.27E-08	B B 2			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	5.80E-04	B B 2			Cf 251		8		
Sm 147		8			Cf 252	4.94E-08	C C 2		
Sm 151		8			Unsp a				
Eu 152	4.29E-01	B B 2			Unsp b/g				
Eu 154	< 9.12E-01	C 3			Total a	5.94E-01	*	0	*
Eu 155	< 2.03E-05	C 3			Total b/g	1.34E+01	*	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 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