

WASTE STREAM	5C30	Harwell Remote Handled ILW
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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	= 17.6		
Future arisings:				
Total future arisings:		0.0		
Total waste volume:		17.6		

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

Comment on arising rates: -

Additional information on quantities: Volume is that of the waste cans outer containers, which by default are part of the waste stream. Voidage within is variable and difficult to estimate. The waste is contained in steel or stainless steel containers. Wherever possible the empty containers are size reduced and consigned as LLW. Any cans whose contents and dose rates have decayed to levels commensurate with LLW disposal may also be diverted to that route. The overall percentage of diverted wastes is small and it is not practicable to reliably estimate the volume of waste diverted in this way.

Uncertainty factors on volumes:

Stock (upper):	x 1.20	Arisings (upper):	x -
Stock (lower):	x 0.80	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. This waste represents legacy ILW in storage tubes. In addition there has been water/sludge found inside some of the tubes.

PHYSICAL CHARACTERISTICS

General description: Laboratory/ cell wastes, sources, cut-up experimental rigs, glassware and concrete. Most wastes in cans (max 50 litres). Once retrieved the waste is re-classified as either stream 5C52 or 5C318 as appropriate. Some acids/ alkalis/ oxidants/reductants may be present, but bulk of waste is inert.

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	The identity of steels/other alloys is unknown.	
Other ferrous metals.....	~ 21.0	-	
Iron.....	-	-	
Aluminium.....	~ 33.0	-	
Beryllium.....	-	-	
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 cellulotics.....	~ 12.0	-	
Paper, cotton.....	~ 11.8	-	
Wood.....	~ 0.20	-	
Halogenated plastics.....	< 13.0	-	
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	-	
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 0	-	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	~ 2.0	-	
Sand.....	-	-	
Glass/Ceramics.....	~ 1.7	-	
Graphite.....	~ 1.0	-	
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.....	TR	-

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 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 packaged 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. Wastes not meeting acceptance criteria and requiring additional treatment (WRATs) is re-classified as stream 5C318.

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	44	-

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: Data has been re-evaluated and allows for decay. However, most still relies on the accuracy of original information, dating back as far as 1950s, which often does not include all potentially significant radioisotopes. Thus it is difficult to estimate the level of uncertainty, particularly of minor isotopes.

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	5.35E-02	C C 2			Gd 153	1.52E-06	B B 2		
Be 10	1.12E-03	B C 2			Ho 163				8
C 14	8.25E-06	C C 2			Ho 166m				8
Na 22					Tm 170				8
Al 26					Tm 171				8
Cl 36	9.63E-05	B B 2			Lu 174				8
Ar 39					Lu 176				8
Ar 42					Hf 178n				8
K 40					Hf 182				8
Ca 41	1.29E-05	B B 2			Pt 193				8
Mn 53					Ti 204	3.91E-08	B C 2		
Mn 54	2.84E-06	C C 2			Pb 205	< 1.31E-06	B 3		
Fe 55	1.47E-01	B B 2			Pb 210	3.96E-03	B C 2		
Co 60	2.19E+01	B B 2			Bi 208				8
Ni 59	1.05E-01	B B 2			Bi 210m				8
Ni 63	6.46E+00	B B 2			Po 210	3.93E-03	C C 2		
Zn 65					Ra 223	6.75E-05	C C 2		
Se 79	1.28E-08	C C 2			Ra 225	3.74E-06	C C 2		
Kr 81					Ra 226	5.38E-03	C C 2		
Kr 85	1.64E-01	B B 2			Ra 228	2.69E-08	B C 2		
Rb 87	3.57E-08	C C 2			Ac 227	6.73E-05	C C 2		
Sr 90	6.58E+00	B C 2			Th 227	6.65E-05	C C 2		
Zr 93	1.59E-03	B B 2			Th 228	1.28E-05	C C 2		
Nb 91					Th 229	3.75E-06	C C 2		
Nb 92					Th 230	4.61E-07	B C 2		
Nb 93m	1.37E-03	B B 2			Th 232	3.27E-08	B C 2		
Nb 94	4.46E-03	B B 2			Th 234	3.17E-05	C C 2		
Mo 93	3.22E-04	B C 2			Pa 231	8.00E-09	B C 2		
Tc 97					Pa 233	1.62E-06	C C 2		
Tc 99	4.43E-03	B B 2			U 232	1.22E-05	B C 2		
Ru 106	3.02E-07	B B 2			U 233	3.31E-03	B C 2		
Pd 107	2.63E-09	C C 2			U 234	2.02E-04	B C 2		
Ag 108m	3.38E-05	B B 2			U 235	4.73E-06	B C 2		
Ag 110m					U 236	4.48E-07	B C 2		
Cd 109	4.13E-07	B B 2			U 238	3.17E-05	B C 2		
Cd 113m	1.57E+00	B B 2			Np 237	1.62E-06	C C 2		
Sn 119m					Pu 236				8
Sn 121m	2.88E-01	C C 2			Pu 238	5.34E-02	C C 2		
Sn 123					Pu 239	2.03E-02	C C 2		
Sn 126	2.45E-08	B C 2			Pu 240	1.75E-02	C C 2		
Sb 125	< 2.84E-03	C 3			Pu 241	4.59E-01	C C 2		
Sb 126	3.43E-09	C C 2			Pu 242	4.53E-04	C C 2		
Te 125m	7.10E-04	C C 2			Am 241	1.01E-01	C C 2		
Te 127m					Am 242m	5.08E-07	B C 2		
I 129	7.71E-06	B B 2			Am 243	1.22E-04	C C 2		
Cs 134	2.48E-04	B B 2			Cm 242	4.19E-07	C C 2		
Cs 135	2.45E-04	B C 2			Cm 243	1.52E-05	C C 2		
Cs 137	1.57E+01	B B 2			Cm 244	1.09E-03	C C 2		
Ba 133	1.89E-07	B B 2			Cm 245	7.36E-09	B C 2		
La 137					Cm 246	2.06E-09	B C 2		
La 138					Cm 248				8
Ce 144	4.81E-08	B B 2			Cf 249	4.96E-09	B C 2		
Pm 145					Cf 250	1.11E-07	B C 2		
Pm 147	5.77E-03	B B 2			Cf 251	1.18E-09	B C 2		
Sm 147					Cf 252	6.04E-07	C C 2		
Sm 151	2.76E-04	B B 2			Unsp a				
Eu 152	5.74E+00	B B 2			Unsp b/g				
Eu 154	< 1.24E+01	C 3			Total a	2.07E-01	*	0	*
Eu 155	< 5.05E-01	C 3			Total b/g	7.21E+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