

WASTE STREAM**5C18/C****Encapsulated ILW Liquors****SITE** Harwell**SITE OWNER** Nuclear Decommissioning Authority**WASTE CUSTODIAN** Magnox Limited**WASTE TYPE** ILWIs the waste subject to
Scottish Policy:

No

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	16.4 m ³	23.4 m ³

Total future arisings:		0 m ³	0 m ³
------------------------	--	------------------	------------------

Total waste volume:		16.4 m ³	23.4 m ³
---------------------	--	---------------------	---------------------

Number of waste packages in stock:	At 1.4.2022.....	41 package(s)
---------------------------------------	------------------	---------------

Comment on volumes: All the Stored Legacy ILW liquors (5C18) have been encapsulated. Some of the conditioned liquors have been re-characterised as LLW and consigned to LLWR. Volume is well defined because all waste is encapsulated in 500L drums.

Uncertainty factors on volumes:	Stock (upper): x 1.05	Arisings (upper) x
	Stock (lower): x 0.95	Arisings (lower) x

WASTE SOURCE Encapsulation of laboratory wastes from development of fuel processing, the fast reactor programme and various radiochemical investigations.

PHYSICAL CHARACTERISTICS

General description: Solid waste made up of primarily cement grouting contaminated with fission products, activation products and actinides. The waste was acidic with the original liquors having a pH of 0.36 to 0.98. After mixing with grout it is alkaline.

Physical components (%vol): Solids 100%

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~2

Comment on density: This is the mean bulk density at 100% solids (as stored).

CHEMICAL COMPOSITION

**General description and
components (%wt):** Encapsulated solid waste containing uranium(21% w/v), nitrate (1.3-4.0% w/v), thorium (up to 3.0% w/v), sulphate (0.1-0.3% w/v) and chloride (0.1% w/v)

Chemical state: Alkali

**Chemical form of
radionuclides:** H-3: Incorporated in cement grouting

Cl-36: Soluble salts incorporated in cement grouting

I-129: Soluble salts incorporated in cement grouting

Ra: Soluble salts incorporated in cement grouting

Th: Soluble salts incorporated in cement grouting

U: Soluble salts and U235 present as depleted uranium, incorporated in cement grouting

Pu: Soluble salts incorporated in cement grouting

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	0		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....			
Copper.....	0		

WASTE STREAM**5C18/C****Encapsulated ILW Liquors**

Lead.....	0	
Magnox/Magnesium.....	0	
Nickel.....		
Titanium.....		
Uranium.....	0	
Zinc.....	0	
Zircaloy/Zirconium.....	0	
Other metals.....	0	Uranium and thorium are present, but are incorporated with grout minerals and so not present as pure metals.

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics	0		
Total non-halogenated plastics....	0		
Condensation polymers.....	0		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0		
Halogenated rubber	0		
Non-halogenated rubber.....	0		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	100.0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....			

Asbestos.....	0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): Values given are from sampling and analysis of the liquors, and by taking into account the change in density of the waste following encapsulation.

	(%wt)	Type(s) and comment
Fluoride.....		
Chloride.....	0.10	
Iodide.....		
Cyanide.....		
Carbonate.....		
Nitrate.....	4.0	
Nitrite.....		
Phosphate.....	0.20	
Sulphate.....	0.30	
Sulphide.....		

Materials of interest for waste acceptance criteria: Encapsulated free liquids will not present any non-radiological hazard.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
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.....		

WASTE STREAM**5C18/C****Encapsulated ILW Liquors**

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.....

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

(%wt) Type(s) and comment

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants..... 0.01 The waste contains tributyl phosphate (0.01%)

Total complexing agents..... 0.01

Potential for the waste to contain discrete items:

Yes. Grouted drums are considered to be DIs

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
500 l drum (pre-cast annular)	100.0	0.4	0.4	41

Container type comment:

-

Range in container waste volume:

-

Other information on containers:

-

Conditioned density (t/m³):

2.0

Conditioned density comment:

Weight of conditioned waste in each drum = 772kg. Volume of original waste in each drum = 386 litres. Density range 1.95 to 2.03 t/m³.

Other information on conditioning:

-

RADIOACTIVITY

Source:

-

Uncertainty:

Tritium, mixed fission products, activation products and actinides from MTR operations, laboratory investigations and decontamination operations.

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:

The specific activities have been derived measurements of the liquors. Activity data needs to be reassessed post-2022 UKRWI due to changes noted in Magnox Technical Note 462/TN/1379

Other information:

-

WASTE STREAM

5C18/C

Encapsulated ILW Liquors

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	1.11E-03	A A 1			Gd 153		8		
Be 10			8		Ho 163		8		
C 14			8		Ho 166m		8		
Na 22			8		Tm 170		8		
Al 26			8		Tm 171		8		
Cl 36			8		Lu 174		8		
Ar 39			8		Lu 176		8		
Ar 42			8		Hf 178n		8		
K 40			8		Hf 182		8		
Ca 41			8		Pt 193		8		
Mn 53			8		Tl 204		8		
Mn 54			8		Pb 205		8		
Fe 55			8		Pb 210	3.03E-04	A A 1		
Co 60	2.68E-04	A A 1			Bi 208		8		
Ni 59			8		Bi 210m		8		
Ni 63	3.50E-06	A A 1			Po 210	2.96E-04	A A 1		
Zn 65			8		Ra 223	1.25E-06	B B 2		
Se 79			8		Ra 225		8		
Kr 81			8		Ra 226	7.09E-04	B B 1		
Kr 85			8		Ra 228	1.07E-04	A A 1		
Rb 87			8		Ac 227	1.25E-06	B B 1		
Sr 90	2.23E-03	A A 1			Th 227	1.23E-06	B B 2		
Zr 93			8		Th 228	1.03E-04	B B 1		
Nb 91			8		Th 229		8		
Nb 92			8		Th 230	2.56E-07	B B 2		
Nb 93m			8		Th 232	1.14E-04	B B 1		
Nb 94			8		Th 234	2.48E-03	B B 1		
Mo 93			8		Pa 231	2.89E-06	B B 1		
Tc 97			8		Pa 233	9.92E-08	B B 2		
Tc 99			8		U 232		8		
Ru 106			8		U 233		8		
Pd 107			8		U 234	2.32E-03	B B 1		
Ag 108m			8		U 235	1.14E-04	B B 1		
Ag 110m			8		U 236	1.04E-08	B B 2		
Cd 109			8		U 238	2.48E-03	B B 1		
Cd 113m			8		Np 237	1.00E-07	B B 2		
Sn 119m			8		Pu 236		8		
Sn 121m			8		Pu 238	5.71E-03	B B 1		
Sn 123			8		Pu 239	2.83E-02	B B 1		
Sn 126			8		Pu 240	2.92E-02	B B 1		
Sb 125			8		Pu 241	2.05E-01	A A 1		
Sb 126			8		Pu 242	4.04E-05	B B 1		
Te 125m			8		Am 241	2.79E-02	B B 1		
Te 127m			8		Am 242m		8		
I 129			8		Am 243		8		
Cs 134			8		Cm 242		8		
Cs 135			8		Cm 243		8		
Cs 137	5.18E-02	A A 1			Cm 244	3.91E-04	B B 1		
Ba 133			8		Cm 245		8		
La 137			8		Cm 246		8		
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	1.77E-05	A A 1			Other b/g				
Eu 154	1.02E-05	A A 1			Total a	9.77E-02	B B 1	0	
Eu 155	4.28E-07	A A 1			Total b/g	2.63E-01	B B 1	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