

WASTE STREAM	5C320/C	Encapsulated ILW Sludges
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SITE Harwell
SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	5.2m ³	7.4m ³
Total future arisings:		0 m ³	0 m ³
Total waste volume:		5.2m ³	7.4m ³
Number of waste packages in stock:	At 1.4.2022.....	13 package(s)	

Comment on volumes: All the Stored Legacy ILW sludges have been encapsulated. 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 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 CHARACTERISTICS

General description: Solid waste made up of primarily cement grouting contaminated with fission products, activation products and actinides.

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		
Lead.....	0		

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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 cellulose.....	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		

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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.....	0	
Chloride.....	0.10	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	0	
Nitrate.....	4.0	
Nitrite.....	0	
Phosphate.....	0.20	
Sulphate.....	0.30	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: -

	(%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.....		

Hazardous substances / non hazardous pollutants: None expected

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		

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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 DIs

PACKAGING AND CONDITIONING

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Container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l drum (pre-cast annular)	100.0	0.4	0.4	13

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: Tritium, mixed fission products, activation products and actinides from MTR operations, laboratory investigations and decontamination 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: Derived from measured activities and masses of drums. Activity data needs to be reassessed post-2022 UKRWI due to changes noted in Magnox Technical Note 462/TN/1379

Other information: -

WASTE STREAM 5C320/C Encapsulated ILW Sludges

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	9.42E-05	AA 2			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	5.89E-05	BB 2		
Co 60	7.82E-06	AA 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63	5.43E-04	AA 2			Po 210	5.58E-05	BB 2		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226	2.45E-04	BB 2		
Kr 85		8			Ra 228	1.44E-06	AA 2		
Rb 87		8			Ac 227		8		
Sr 90	1.38E-02	AA 2			Th 227		8		
Zr 93		8			Th 228	1.44E-06	BB 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m		8			Th 232	1.44E-06	BB 2		
Nb 94		8			Th 234	3.9E-05	BB 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	2.18E-05	BB 2		
Ag 108m		8			U 235	1.03E-06	BB 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	3.9E-05	BB 2		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	1.71E-04	BB 2		
Sn 123		8			Pu 239	1.77E-03	BB 2		
Sn 126		8			Pu 240	1.59E-03	BB 2		
Sb 125		8			Pu 241	2.79E-03	AA 2		
Sb 126		8			Pu 242	2.37E-07	BB 2		
Te 125m		8			Am 241	7.77E-04	BB 2		
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	3.62E-02	AA 2			Cm 244		8		
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		8			Other b/g				
Eu 154		8			Total a	4.67E-03	BB 2	0	
Eu 155		8			Total b/g	5.35E-02	BB 2	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