WASTE STREAM 5C320/C Encapsulated ILW Sludges

SITE	Harwell
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	5.2 m³	7.4 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		5.2 m³	7.4 m³
Number of waste packages in stock:	At 1.4.2019.....	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: -

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): -

Stainless steel.....	0
Other ferrous metals.....	0
Iron.....	
Aluminium.....	0
Beryllium.....	0
Cobalt.....	
Copper.....	0
Lead.....	0
Magnox/Magnesium.....	0
Nickel.....	
Titanium.....	

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	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):	-		
	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):	-		
	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	

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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.

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: -

Combustible metals	0
Low flash point liquids	0
Explosive materials	0
Phosphorus	0
Hydrides	0
Biological etc. materials	0
Biodegradable materials	
Putrescible wastes	0
Non-putrescible wastes	
Corrosive materials	0
Pyrophoric materials	0
Generating toxic gases	0
Reacting with water	0
Active particles	
Soluble solids as bulk chemical compounds	

Hazardous substances / non hazardous pollutants: none expected

Acrylamide	
Benzene	
Chlorinated solvents	
Formaldehyde	
Organometallics	
Phenol	
Styrene	
Tri-butyl phosphate	
Other organophosphates	
Vinyl chloride	
Arsenic	
Barium	

	Boron.....		
	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		
	EDTA.....		
	DPTA.....		
	NTA.....		
	Polycarboxylic acids……		
	Other organic complexants.....	0.01	The waste contains tributyl phosphate (0.01%)
	Total complexing agents.....	0.01	

PACKAGING AND CONDITIONING

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/m^3):	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/m^3.
Other information on conditioning:	-

RADIOACTIVITY

Source:	Tritium, mixed fission products, activation products and actinides from MTR operations, laboratory investigations and decontamination operations.
Uncertainty:	-

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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-2019 UKRWI due to changes noted in Magnox Technical Note 462/TN/1379.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	1.12E-04	A A 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	4.11E-05	B B 2		
Co 60	1.16E-05	A A 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63	5.54E-04	A A 2			Po 210	3.76E-05	B B 2		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226	2.45E-04	B B 2		
Kr 85		8			Ra 228	1.44E-06	A A 2		
Rb 87		8			Ac 227		8		
Sr 90	1.48E-02	A A 2			Th 227		8		
Zr 93		8			Th 228	1.44E-06	B B 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m		8			Th 232	1.44E-06	B B 2		
Nb 94		8			Th 234	3.9E-05	B B 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	B B 2		
Ag 108m		8			U 235	1.03E-06	B B 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	3.9E-05	B B 2		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	1.75E-04	B B 2		
Sn 123		8			Pu 239	1.77E-03	B B 2		
Sn 126		8			Pu 240	1.59E-03	B B 2		
Sb 125		8			Pu 241	3.22E-03	A A 2		
Sb 126		8			Pu 242	2.37E-07	B B 2		
Te 125m		8			Am 241	7.66E-04	B B 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	3.88E-02	A A 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**	**4.65E-03**	**B B 2**	**0**	
Eu 155		8			**Total b/g**	**5.76E-02**	**B B 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