WASTE STREAM 9A03/C Ion Exchange Material

SITE	Berkeley
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.....	11.1 m³	38.1 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		11.1 m³	38.1 m³
Number of waste packages in stock:	At 1.4.2022.....	7 package(s)	

Comment on volumes:	Waste conditioned in 2016			
Uncertainty factors on volumes:	Stock (upper):	x 1.1	Arisings (upper)	x
	Stock (lower):	x 0.9	Arisings (lower)	x

WASTE SOURCE Spent ion exchange materials arising from the treatment of pond waters.

PHYSICAL CHARACTERISTICS

General description:	The waste in the tank was easily pumped and had rapid settling characteristics. There are no large items that may require special handling.
Physical components (%wt):	Ion exchange material (100 wt%) including some absorbed water
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m³):	0.88
Comment on density:	Bulk density retrieved from package records and fLoC datasheets. Density of dry resin.

CHEMICAL COMPOSITION

General description and components (%wt):	Composition appropriate to proprietary ion exchange materials, some of which are organic in nature. Water in which some of the material is immersed. Proprietary ion exchange materials: Lewatit DN (phenol formaldehyde) and similar Amberlite IRN74 resin (phenol formaldehyde). About 30% wt will probably be absorbed water. Charge records indicate which IEX material was used.
Chemical state:	Alkali
Chemical form of radionuclides:	H-3: Most tritium is expected to be present as water but some may be in the form of other inorganic compounds or as organic compounds. C-14: Carbon 14 will probably be present as graphite. Cl-36: Chlorine 36 will probably be present as inorganic chloride. Se-79: The selenium content is insignificant. Tc-99: The technetium content is insignificant. Ra: The radium isotope content is insignificant. Th: The thorium isotope content is insignificant. U: The chemical form of uranium isotopes has not been determined but may be oxides. Np: The neptunium content is insignificant. Pu: The chemical form of plutonium isotopes has not been determined but may be oxides.
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.....	<0.01		

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Cobalt		
Copper	0	
Lead	0	
Magnox/Magnesium	0	
Nickel		
Titanium		
Uranium		
Zinc	0	
Zircaloy/Zirconium	0	
Other metals	0	No "other" metals present.

Organics (%wt): Ion exchange resins are present. Lewatit DN (38.7% vol) and Duolite C3 (3.2% vol). Halogenated plastics or rubbers are not present.

	(%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	~41.9	Lewatit DN (38.7% vol) and Duolite C3 (3.2% vol)	
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 present.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	58.1	Synthetic zeolite: AW 500 (1.6% vol), Duocil (22% vol), Decalso Y (32.8% vol). Natural zeolite: Attapulgus clay (1.6% vol).	
Inorganic sludges and flocs	0		
Soil	0		
Brick/Stone/Rubble	0		
Cementitious material	0		
Sand			

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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): Chemical characterisation has shown that some inorganic anions are present, as detailed below.

	(%wt)	Type(s) and comment
Fluoride	NE	
Chloride	0.02	
Iodide	NE	
Cyanide	NE	
Carbonate	1.7	
Nitrate	NE	
Nitrite	NE	
Phosphate	NE	
Sulphate	<0.80	
Sulphide	NE	

Materials of interest for waste acceptance criteria: Phosphorous is the only identified material likely to represent a fire or other non-radiological hazard.

	(%wt)	Type(s) and comment
Combustible metals	0	
Low flash point liquids	0	
Explosive materials	0	
Phosphorus	0.10	
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		

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Hazardous substances / non hazardous pollutants: None expected

	(%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.....		
Total complexing agents.....	TR	

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Potential for the waste to contain discrete items: No. In & of itself not a DI; assumed not likely to contain any "rogue" items that could be.

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
3m^3 RS box	100.0	1.592	1.592	7

Container type comment: -

Range in container waste volume: No significant variability is expected.

Other information on containers: -

Conditioned density (t/m^3): 0.88

Conditioned density comment: Density given is the average from all package records.

Other information on conditioning: -

RADIOACTIVITY

Source: Spent ion exchange materials arisings from the treatment of pond waters. There is expected to be contamination by fission products and activation products including actinides. Caesium-137 is expected to be a dominant nuclide.

Uncertainty: Specific activity is a function of station operating history. The values quoted are based on original characterisation data, scaled to Cs-137 content of each waste package and summed to output waste stream total, then decayed to 2022.

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: Values were derived by extrapolation from available data.

Other information: -

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	1.04E-05	C C 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	3.73E-07	C C 2			Ho 166m	1.7E-05	C C 2		
Na 22		8			Tm 170		8		
Al 26		8		8	Tm 171		8		
Cl 36	3.49E-09	C C 2			Lu 174		8		
Ar 39	1.07E-07	C C 2			Lu 176		8		
Ar 42		8			Hf 178n	2.06E-05	C C 2		
K 40		8			Hf 182		8		
Ca 41	2.15E-09	C C 2			Pt 193	1.37E-07	C C 2		
Mn 53		8			Tl 204	3.02E-07	C C 2		
Mn 54		8			Pb 205		8		
Fe 55	3.59E-07	C C 2			Pb 210		8		
Co 60	1.72E-06	C C 2			Bi 208		8		
Ni 59	5.22E-09	C C 2			Bi 210m		8		
Ni 63	1.58E-04	C C 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	5.78E-08	C C 2			Ra 225		8		
Kr 81	4.84E-09	C C 2			Ra 226		8		
Kr 85	8.32E-04	C C 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	4.02E-02	C C 2			Th 227		8		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	1.94E-08	C C 2			Th 232		8		
Nb 94	5.52E-09	C C 2			Th 234	4.8E-07	C C 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	2.16E-08	C C 2		
Tc 99	2.65E-04	C C 2			U 232		8		
Ru 106		8			U 233	1.89E-09	C C 2		
Pd 107	1.41E-07	C C 2			U 234	4.28E-07	C C 2		
Ag 108m	4.35E-09	C C 2			U 235	1.24E-08	C C 2		
Ag 110m		8			U 236	4.59E-08	C C 2		
Cd 109		8			U 238	4.8E-07	C C 2		
Cd 113m	3.39E-06	C C 2			Np 237	2.16E-08	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	4.7E-05	C C 2		
Sn 123		8			Pu 239	1.1E-04	C C 2		
Sn 126	5.25E-07	C C 2			Pu 240	1.09E-04	C C 2		
Sb 125	1.68E-07	C C 2			Pu 241	1.37E-03	C C 2		
Sb 126	7.35E-08	C C 2			Pu 242	8.28E-08	C C 2		
Te 125m	4.2E-08	C C 2			Am 241	1.68E-04	C C 2		
Te 127m		8			Am 242m	4.77E-07	C C 2		
I 129	4.92E-07	C C 2			Am 243	1.55E-07	C C 2		
Cs 134	6.89E-07	C C 2			Cm 242	3.94E-07	C C 2		
Cs 135	1.05E-06	C C 2			Cm 243	5.32E-08	C C 2		
Cs 137	7.09E-01	C C 1			Cm 244	5.99E-07	C C 2		
Ba 133	8.49E-09	C C 2			Cm 245		8		
La 137	1.6E-09	C C 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	2.03E-08	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.87E-05	C C 2			Other a				
Eu 152		8			Other b/g				
Eu 154	7.31E-08	C C 2			**Total a**	**4.36E-04**	**C C 2**	**0**	
Eu 155		8			**Total b/g**	**7.52E-01**	**C C 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