

WASTE STREAM	9A03/C	Ion Exchange Material
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SITE Berkeley

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	14.2 m ³	38.1 m ³
Total future arisings:		0 m ³	0 m ³
Total waste volume:		14.2 m ³	38.1 m ³
Number of waste packages in stock:	At 1.4.2019.....	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: -

Bulk density (t/m³): 1.1

Comment on density: The assumed bulk density of 1.1 t/m³ may be revised by about 10% in future Inventories.

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.

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): -

Stainless steel.....	0
Other ferrous metals.....	0
Iron.....	
Aluminium.....	0
Beryllium.....	<0.01
Cobalt.....	
Copper.....	0
Lead.....	0
Magnox/Magnesium.....	0

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	Nickel.....	
	Titanium.....	
	Uranium.....	
	Zinc..... 0	
	Zircaloy/Zirconium..... 0	
	Other metals..... 0	No "other" metals present.
Organics (%wt):	Ion exchange resins are present. Lewatit DN and similar Amberlite resin (phenol formaldehyde). Halogenated plastics or rubbers are not present.	
	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.... ~100.0	Lewatit DN and similar Amberlite resin (phenol formaldehyde).
	Total rubber..... 0	
	Halogenated rubber 0	
	Non-halogenated rubber..... 0	
	Hydrocarbons.....	
	Oil or grease 0	
	Fuel..... 0	
	Asphalt/Tarmac (cont.coal tar)... 0	
	Asphalt/Tarmac (no coal tar).... 0	
	Bitumen..... 0	
	Others..... 0	
	Other organics..... 0	
Other materials (%wt):	-	
	Inorganic ion exchange materials. 0	
	Inorganic sludges and flocs..... 0	
	Soil..... 0	
	Brick/Stone/Rubble..... 0	
	Cementitious material..... 0	
	Sand..... 0	
	Glass/Ceramics..... 0	
	Graphite..... 0	
	Desiccants/Catalysts..... 0	
	Asbestos..... 0	
	Non/low friable..... 0	
	Moderately friable..... 0	
	Highly friable..... 0	
	Free aqueous liquids..... 0	
	Free non-aqueous liquids..... 0	

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	Powder/Ash.....	0
Inorganic anions (%wt):	The presence of inorganic anions has not been fully assessed. The estimates given will be subject to amendment when measurements are made. Some anions may be removed in effluent water when the waste is conditioned.	
	Fluoride.....	<<0.01
	Chloride.....	<0.01
	Iodide.....	<<0.01
	Cyanide.....	0
	Carbonate.....	~2.0
	Nitrate.....	NE
	Nitrite.....	NE
	Phosphate.....	NE
	Sulphate.....	<0.01
	Sulphide.....	NE
Materials of interest for waste acceptance criteria:	There are no identified materials likely to represent a fire or other non-radiological hazard.	
	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.....	

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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.....
 Total complexing agents..... TR

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	2.03	2.03	7

Container type comment: -
 Range in container waste volume: No significant variability is expected.
 Other information on containers: -
 Conditioned density (t/m³): -
 Conditioned density comment: -
 Other information on conditioning: -

RADIOACTIVITY

Source: Spent ion exchange materials arising from the treatment of pond waters. There is expected to be contamination by fission products and activation products including

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Uncertainty:	actinides. Caesium-137 is expected to be a dominant nuclide. Specific activity is a function of Station operating history. The values quoted are indicative of the activities that are expected.
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:	-

WASTE STREAM 9A03/C Ion Exchange Material

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	1.53E-06	CC 2			Gd 153		8		
Be 10	3E-09	CC 2			Ho 163		8		
C 14	2.00E-07	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26	6E-07	CC 2			Tm 171		8		
Cl 36	1E-06	CC 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	4E-07	CC 2			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	9.40E-08	CC 2			Pb 210		8		
Co 60	6.18E-06	CC 2			Bi 208		8		
Ni 59	4E-07	CC 2			Bi 210m		8		
Ni 63	9.20E-06	CC 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	5.17E-08	CC 2			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	3.76E-02	CC 2			Th 227		8		
Zr 93	2E-06	CC 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	1.09E-06	CC 2			Th 232		8		
Nb 94		8			Th 234	7E-08	CC 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	2E-06	CC 2		
Tc 99	2E-05	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107	7E-08	CC 2			U 234	3.00E-07	CC 2		
Ag 108m		8			U 235	7E-09	CC 2		
Ag 110m		8			U 236	7.00E-09	CC 2		
Cd 109		8			U 238	7E-08	CC 2		
Cd 113m	2.2E-07	CC 2			Np 237	2E-06	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m	7.67E-03	CC 2			Pu 238	9.10E-06	CC 2		
Sn 123		8			Pu 239	2E-05	CC 2		
Sn 126	3.04E-07	CC 2			Pu 240	3.00E-05	CC 2		
Sb 125	9.65E-08	CC 2			Pu 241	3.93E-04	CC 2		
Sb 126	4.26E-08	CC 2			Pu 242	2E-08	CC 2		
Te 125m	2.42E-08	CC 2			Am 241	6.89E-05	CC 2		
Te 127m		8			Am 242m	9.43E-08	CC 2		
I 129	9E-09	CC 2			Am 243	5.00E-08	CC 2		
Cs 134	7.12E-07	CC 2			Cm 242	7.78E-08	CC 2		
Cs 135	5E-06	CC 2			Cm 243	4.55E-08	CC 2		
Cs 137	3.03E-01	CC 2			Cm 244	4.42E-07	CC 2		
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	3.77E-07	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.83E-04	CC 2			Other a				
Eu 152	1.62E-06	CC 2			Other b/g				
Eu 154	1.14E-06	CC 2			Total a	1.31E-04	CC 2	0	
Eu 155	5.51E-07	CC 2			Total b/g	3.49E-01	CC 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