

WASTE STREAM	9A25/C	Ion Exchange Material in Drums
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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.....	40.0 m ³	87.0 m ³
Total future arisings:		0 m ³	0 m ³
Total waste volume:		40.0 m ³	87.0 m ³
Number of waste packages in stock:	At 1.4.2022.....	16 package(s)	

Comment on volumes: Station operation ceased in March 1989. Accumulation of this type of waste in drums ceased in June 1980. The volume of the waste was re-assessed prior to the 2004 Inventory.

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. The material was packaged in modified '45 gallon' mild steel drums. One of the drums is reported as being a dummy unit containing sand/gravel.

PHYSICAL CHARACTERISTICS

General description: The waste arose from an early method of controlling the caesium levels in the BPS fuel ponds. Drums containing ion exchange materials were submerged in the ponds and the pond water was pumped through the ion exchanger. The materials (Duocil, Decalso Y and Lewatit DN) were granular when they were loaded into the drums. The drums were drained before being placed in the vaults. The empty drums are included in the waste stream 9A917, but will be processed with the Miscellaneous Contaminated Items streams (9A36, 9A37 and 9A38). There are no large items that may require special handling.

Physical components (%vol): The waste is 53.3%vol inorganic ion exchange material, 45.3%vol organic material and 1.3%vol sand or gravel.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1

Comment on density: The assumption of 1 t/m³ as the average bulk density may be subject to revision.

CHEMICAL COMPOSITION

General description and components (%wt): Some drums contain alumino-silicate, an inorganic ion exchange material, known as Duocil and Decalso Y. Some drums contain phenol formaldehyde, an organic ion exchange material, known as Lewatit DN and Amberlite Y. Drums may contain sand or gravel.

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 probably will be uranium oxides.
 Np: The neptunium content is insignificant.
 Pu: The chemical form of plutonium isotopes has not been determined but probably will be plutonium oxides.

Metals and alloys (%wt): No sheet or bulk metal items present.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE	There may be small contamination (<1% wt) by stainless and mild steel. The drum is not included in this waste stream.	
Other ferrous metals.....	NE	There may be small contamination (<1% wt) by stainless and mild steel. The drum is not included in this waste stream.	
Iron.....			
Aluminium.....	0		
Beryllium.....	<0.01		
Cobalt.....			
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	TR		
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	0		
Zircaloy/Zirconium.....	TR		
Other metals.....	0	No "other" metals present.	
Organics (%wt):		Ion exchange resins are present. Lewatit DN and Amberlite Y (~45% 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....	~45.0		
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):		Traces of graphite may be present.	

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	(%wt)	Type(s) and comment		% of total C14 activity
Inorganic ion exchange materials..	~53.0			
Inorganic sludges and flocs.....	0			
Soil.....	0			
Brick/Stone/Rubble.....	<1.3			
Cementitious material.....	0			
Sand.....	<1.3			
Glass/Ceramics.....	0			
Graphite.....	TR			
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): The presence of inorganic anions shown in the table has not been fully assessed.

	(%wt)	Type(s) and comment
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: Organic ion exchange material swells in water. If it is not fully saturated prior to being encapsulated in the Nirex drum, it is likely to swell in the grout, potentially causing problems with cracking of the wasteform.

	(%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.....		

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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 / None expected
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.....		

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....		TR

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	~2.5	2.5	16

Container type comment: -

Range in container waste volume: -

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 water. 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 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: -

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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	8.63E-06	CC 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	9.99E-08	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	7E-09	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		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	1.97E-08	CC 2			Pb 210		8		
Co 60	4.17E-07	CC 2			Bi 208		8		
Ni 59	3E-08	CC 2			Bi 210m		8		
Ni 63	6.31E-06	CC 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1.72E-07	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	1.39E-01	CC 2			Th 227		8		
Zr 93	1E-05	CC 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	6.24E-06	CC 2			Th 232		8		
Nb 94	5.00E-09	CC 2			Th 234	8E-07	CC 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	9.25E-08	CC 2		
Tc 99	6E-05	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	6.04E-07	CC 2		
Ag 108m	<2.94E-08	C 3			U 235	2E-08	CC 2		
Ag 110m		8			U 236	9.00E-08	CC 2		
Cd 109		8			U 238	8E-07	CC 2		
Cd 113m		8			Np 237	9.25E-08	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	7.12E-05	CC 2		
Sn 123		8			Pu 239	3E-04	CC 2		
Sn 126	1.3E-06	CC 2			Pu 240	2.00E-04	CC 2		
Sb 125	1.14E-06	CC 2			Pu 241	1.46E-03	CC 2		
Sb 126	1.82E-07	CC 2			Pu 242	2E-07	CC 2		
Te 125m	2.85E-07	CC 2			Am 241	5.39E-04	CC 2		
Te 127m		8			Am 242m	1.85E-06	CC 2		
I 129	1E-07	CC 2			Am 243	7.00E-07	CC 2		
Cs 134	1.94E-07	CC 2			Cm 242	1.53E-06	CC 2		
Cs 135	3E-05	CC 2			Cm 243	3.54E-07	CC 2		
Cs 137	2.13E+00	CC 2			Cm 244	2.25E-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	1.71E-06	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	4.45E-04	CC 2			Other a				
Eu 152		8			Other b/g				
Eu 154	1.50E-05	CC 2			Total a	1.11E-03	CC 2	0	
Eu 155	1.19E-06	CC 2			Total b/g	2.27E+00	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