

WASTE STREAM	9B81/C	FED Magnox - Secondary Ion Exchange Resin (Co-Treat)
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SITE Bradwell
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.....	0.6 m ³	2.5 m ³
Total future arisings:		0 m ³	0 m ³
Total waste volume:		0.6 m ³	2.5 m ³
Number of waste packages in stock:	At 1.4.2022.....	2 package(s)	

Comment on volumes: Volume calculated based on voidage calculations,
 Uncertainty factors on volumes: Stock (upper): x 1.1 Arisings (upper) x
 Stock (lower): x 0.9 Arisings (lower) x

WASTE SOURCE The secondary Ion exchange resin originates in the ADAP from the abatement of FED dissolution discharges. The ADAP plant used Co-Treat and Cs-Treat proprietary Ion Exchange (IX) resins to remove soluble radioactive components from the effluent, minimising the activity discharged to the environment. This waste stream refers to the Co-Treat.

PHYSICAL CHARACTERISTICS

General description: Spent CoTreat (100%) resin from the FED effluent activity abatement. There are no large items which may cause special handling
 Physical components (%wt): 100 wt% Co-Treat resin, with some bound water (~35 wt%)
 Sealed sources: The waste does not contain sealed sources.
 Bulk density (t/m³): 0.64
 Comment on density: The bulk density of the waste was calculated using the known mass and volume of the wastestream.

CHEMICAL COMPOSITION

General description and components (%wt): Ion Exchange material ~100% wt (of which 35% wt is absorbed water).
 Chemical state: Alkali
 Chemical form of radionuclides: H-3: Likely present as water.
 Cl-36: The chemical form of chlorine 36 may be inorganic chloride.
 U: The chemical form of uranium isotopes has not been determined but will probably be uranium oxides.
 Pu: The chemical form of plutonium isotopes has not been determined but will probably be plutonium oxides.
 Metals and alloys (%wt): No bulk or sheet metal items.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....	NE		
Iron.....			
Aluminium.....	NE		
Beryllium.....	TR		
Cobalt.....			
Copper.....	NE		

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Lead.....	TR
Magnox/Magnesium.....	0
Nickel.....	
Titanium.....	
Uranium.....	
Zinc.....	NE
Zircaloy/Zirconium.....	NE
Other metals.....	NE

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): 100% inorganic Co-Treat resin. There are no halogenated plastics or rubbers present.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	~100.0	Co-Treat - Sodium titanium oxide granules	100.0
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	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..... TR

Powder/Ash..... 0

Inorganic anions (%wt): -

(%wt) Type(s) and comment

Fluoride..... NE

Chloride..... NE

Iodide..... NE

Cyanide..... 0

Carbonate..... NE

Nitrate..... NE

Nitrite..... NE

Phosphate..... NE

Sulphate..... NE

Sulphide..... NE

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..... NE

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): No

(%wt) Type(s) and comment

EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

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

WASTE STREAM**9B81/C****FED Magnox - Secondary Ion Exchange Resin (Co-Treat)**

Container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l RS drum (0mm Pb)	100.0	0.29	0.29	2

Container type comment: Packed into 2 MOSAIK T/ISAR IP-2

Range in container waste volume: Single resin bed per MOSAIK

Other information on containers: -

Conditioned density (t/m³): 0.64

Conditioned density comment: Conditioned density calculated using total wastream mass and volume.

Other information on conditioning: -

RADIOACTIVITY

Source: The activity originates from Magnox FED which has been dissolved in the dissolution process and the resulting effluent abated within ADAP. Co-Treat is one of the abatement steps in ADAP specifically to target Co-60. The activity arises from activation products, fission products and fuel route.

Uncertainty: The fingerprints are conservative upper limits based upon the mass and activity of FED processed through ADAP.

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: Cs-137 and Co-60 both measured using in-situ gamma spectroscopy. Other radionuclides are taken from the specific activity of one package, as the inventory was calculated assuming all activity of FED was present in one package. Decayed to 01/04/2022.

Other information: -

WASTE STREAM 9B81/C FED Magnox - Secondary Ion Exchange Resin (Co-Treat)

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	9.10E+00	CC 2			Gd 153		8		
Be 10	3.47E-05	CC 2			Ho 163	5.66E-08	CC 2		
C 14	1.42E-01	CC 2			Ho 166m	4.82E-09	CC 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	3.22E-08	CC 2		
Cl 36	1.38E-02	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	4.33E-02	CC 2			Pt 193		8		
Mn 53		8			Tl 204	4.43E-03	CC 2		
Mn 54	1.22E-07	CC 2			Pb 205		8		
Fe 55	5.40E-02	CC 2			Pb 210	5.15E-08	CC 2		
Co 60	8.44E-03	CC 2			Bi 208	1.23E-02	CC 2		
Ni 59	5.02E-03	CC 2			Bi 210m	2.85E-09	CC 2		
Ni 63	3.20E-01	CC 2			Po 210	3.33E-05	CC 2		
Zn 65	5.49E-08	CC 2			Ra 223		8		
Se 79	2.9E-06	CC 2			Ra 225	2.18E-08	CC 2		
Kr 81		8			Ra 226	3.63E-07	CC 2		
Kr 85	2.22E-02	CC 2			Ra 228		8		
Rb 87		8			Ac 227	1.07E-02	CC 2		
Sr 90	3.63E-02	CC 2			Th 227		8		
Zr 93	2.5E-05	CC 2			Th 228	2.21E-07	CC 2		
Nb 91		8			Th 229	2.6E-08	CC 2		
Nb 92		8			Th 230	1.2E-06	CC 2		
Nb 93m	1.3E-05	CC 2			Th 232	2.71E-07	CC 2		
Nb 94	1.71E-04	CC 2			Th 234	2.86E-09	CC 2		
Mo 93	1.98E-06	CC 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	1.26E-04	CC 2			U 232	7.05E-06	CC 2		
Ru 106	4.55E-06	CC 2			U 233	4.67E-05	CC 2		
Pd 107	1.43E-06	CC 2			U 234	1.08E-05	CC 2		
Ag 108m	2.69E-02	CC 2			U 235	2.21E-07	CC 2		
Ag 110m	1.14E-08	CC 2			U 236	1.2E-06	CC 2		
Cd 109	2.05E-07	CC 2			U 238	4.17E-06	CC 2		
Cd 113m	4.28E-02	CC 2			Np 237	4.99E-04	CC 2		
Sn 119m	1.22E-09	CC 2			Pu 236	4.36E-08	CC 2		
Sn 121m	3.3E-03	CC 2			Pu 238	4.79E-03	CC 2		
Sn 123		8			Pu 239	1.52E-02	CC 2		
Sn 126	6.29E-06	CC 2			Pu 240	1.84E-02	CC 2		
Sb 125	8.43E-04	CC 2			Pu 241	1.06E-01	CC 2		
Sb 126	8.81E-07	CC 2			Pu 242	1.13E-04	CC 2		
Te 125m	2.11E-04	CC 2			Am 241	2.28E-02	CC 2		
Te 127m		8			Am 242m	3.57E-05	CC 2		
I 129	2.7E-07	CC 2			Am 243	1.36E-05	CC 2		
Cs 134	9.57E-04	CC 2			Cm 242	1.88E-02	CC 2		
Cs 135	7.52E-06	CC 2			Cm 243	3E-04	CC 2		
Cs 137	1.53E-02	CC 2			Cm 244	2.62E-04	CC 2		
Ba 133	7.57E-04	CC 2			Cm 245	9.04E-09	CC 2		
La 137	4.09E-07	CC 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	1.97E-07	CC 2			Cf 249		8		
Pm 145	4.51E-04	CC 2			Cf 250		8		
Pm 147	1.85E-03	CC 2			Cf 251		8		
Sm 147	2.95E-09	CC 2			Cf 252		8		
Sm 151	2.42E-03	CC 2			Other a				
Eu 152	9.27E-04	CC 2			Other b/g				
Eu 154	1.86E-03	CC 2			Total a	<8.13E-02	CC 3	0	
Eu 155	5.77E-04	CC 2			Total b/g	<9.98E+00	CC 3	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