

WASTE STREAM	9B85/C	FED Magnox - Secondary Ion Exchange Resin (Cs-Treat)
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SITE Bradwell
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	0.4 m ³	1.3 m ³
Total future arisings:		0 m ³	0 m ³
Total waste volume:		0.4 m ³	1.3 m ³
Number of waste packages in stock:	At 1.4.2019.....	1 package(s)	
Comment on volumes:	-		
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 will use 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 Cs-Treat.

PHYSICAL CHARACTERISTICS

General description: Spent CsTreat resin from the FED effluent activity abatement.
 Physical components (%wt): 100 wt% Cs-Treat resin, with bound water (35 wt%)
 Sealed sources: -
 Bulk density (t/m³): ~1.1
 Comment on density: The bulk density of the waste ranges from 1.05 to 1.15 t/m³ and includes absorbed water. The average is 1.1 t/m³. This assumes that density is for materials within the abatement modules.

CHEMICAL COMPOSITION

General description and components (%wt): Ion exchange material (100 wt%) of which 35% wt is absorbed water. Other minor items/components ~1% wt are not assessed.
 Chemical state: Alkali
 Chemical form of radionuclides: H-3: Likely present as water.
 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.
 Stainless steel..... NE
 Other ferrous metals..... NE
 Iron.....
 Aluminium..... NE
 Beryllium.....
 Cobalt.....
 Copper..... NE
 Lead..... TR
 Magnox/Magnesium..... <1.0
 Nickel.....
 Titanium.....

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	Uranium.....		
	Zinc.....	NE	
	Zircaloy/Zirconium.....	NE	
	Other metals.....	NE	The "other" metal content has not been fully assessed.
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):	100% inorganic Cs-Treat resin.		
	Inorganic ion exchange materials.	~100.0	Cs-treat
	Inorganic sludges and flocs.....	0	
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	0	
	Sand.....		
	Glass/Ceramics.....	0	
	Graphite.....	0	
	Desiccants/Catalysts.....		
	Asbestos.....	0	
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....		
	Free non-aqueous liquids.....	TR	
	Powder/Ash.....	0	
Inorganic anions (%wt):	Not fully assessed. Carbonates are expected to be present.		

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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:

-	
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.....	NE
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.....	

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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):

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
	500 l RS drum (0mm Pb)	100.0	0.354	0.354	1

Container type comment: -

Range in container waste volume: Single resin bed per MOSAIK

Other information on containers: -

Conditioned density (t/m³): -

Conditioned density comment: -

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. Cs-Treat is one of the abatement steps in ADAP specifically to target Caesium. 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

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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:

Cs-137 and Co-60 both measured using in-situ gamma spectroscopy.

Other information:

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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	<1.67E+01	E 3			Gd 153		8		
Be 10	<5.39E-05	D 3			Ho 163	<5.92E-06	D 3		
C 14	<2.21E-01	D 3			Ho 166m	<7.49E-09	D 3		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	<9.17E-05	D 3		
Cl 36	<2.14E-02	D 3			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	<6.62E-02	D 3			Pt 193		8		
Mn 53		8			Tl 204	<6.06E-03	D 3		
Mn 54	<2E-06	D 3			Pb 205		8		
Fe 55	<5.17E-02	D 3			Pb 210	<9.46E-08	D 8		
Co 60	6.38E-03	BB 1			Bi 208		8		
Ni 59	<2.85E-03	D 3			Bi 210m		8		
Ni 63	<1.85E-01	D 3			Po 210	<8.61E-08	D 3		
Zn 65	<5.43E-07	D 3			Ra 223		8		
Se 79	<4.5E-06	D 3			Ra 225	<4.07E-08	D 3		
Kr 81		8			Ra 226	<5.63E-07	D 3		
Kr 85	<4.20E-02	D 3			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	<5.86E-02	D 3			Th 227		8		
Zr 93	<2.49E-05	D 3			Th 228	<9.8E-06	D 3		
Nb 91		8			Th 229	<4.11E-08	D 3		
Nb 92		8			Th 230	<4.79E-09	D 3		
Nb 93m	<1.68E-05	D 3			Th 232		8		
Nb 94	<2.66E-04	D 3			Th 234	<1E-05	D 3		
Mo 93	<3.08E-06	D 3			Pa 231		8		
Tc 97		8			Pa 233	<1.41E-06	D 3		
Tc 99	<1.96E-04	D 3			U 232	<1.08E-05	D 3		
Ru 106	<5.55E-05	D 3			U 233	<7.25E-05	D 3		
Pd 107	<2.22E-06	D 3			U 234	<1E-05	D 3		
Ag 108m	<3.03E-02	D 3			U 235	<2.04E-07	D 3		
Ag 110m	<2.66E-07	D 3			U 236	<1.87E-06	D 3		
Cd 109	<1.64E-06	D 3			U 238	<1E-05	D 3		
Cd 113m	<7.70E-02	D 3			Np 237	<1.41E-06	D 3		
Sn 119m	<2.54E-08	D 3			Pu 236	<7.39E-09	D 3		
Sn 121m	<5.32E-03	D 3			Pu 238	<1.85E-03	D 3		
Sn 123		8			Pu 239	<6.58E-03	D 3		
Sn 126	<9.78E-06	D 3			Pu 240	<6.58E-03	D 3		
Sb 125	<2.79E-03	D 3			Pu 241	<3.44E-02	D 3		
Sb 126	<1.37E-06	D 3			Pu 242	<8.71E-06	D 3		
Te 125m	<6.97E-04	D 3			Am 241	<9.72E-03	D 3		
Te 127m		8			Am 242m	<8.93E-05	D 3		
I 129	<4.19E-07	D 3			Am 243	<2.12E-05	D 3		
Cs 134	<4.07E-03	D 3			Cm 242	<6.41E-05	D 3		
Cs 135	<1.17E-05	D 3			Cm 243	<1.56E-04	D 3		
Cs 137	4.55E-03	BB 1			Cm 244	<1.43E-04	D 3		
Ba 133	<1.43E-03	D 3			Cm 245	<1.41E-08	D 3		
La 137	<6.35E-07	D 3			Cm 246	<1.05E-09	D 3		
La 138		8			Cm 248		8		
Ce 144	<4.19E-06	D 3			Cf 249		8		
Pm 145	<7.88E-04	D 3			Cf 250		8		
Pm 147	<6.35E-03	D 3			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	<3.74E-03	D 3			Other a				
Eu 152	<1.41E-03	D 3			Other b/g				
Eu 154	<3.28E-03	D 3			Total a	<2.52E-02	D 3	0	
Eu 155	<1.07E-03	D 3			Total b/g	<1.76E+01	D 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