WASTE STREAM 9B85/C FED Magnox - Secondary Ion Exchange Resin (Cs-Treat)

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.....	0.4 m³	1.3 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		0.4 m³	1.3 m³
Number of waste packages in stock:	At 1.4.2022.....	1 package(s)	

Comment on volumes: Volume obtained from 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 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:	The waste does not contain sealed sources.
Bulk density (t/m³):	0.11
Comment on density:	The bulk density of the waste is calculated using the total waste 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.
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.....			
Cobalt.....			
Copper.....	NE		
Lead.....	TR		

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Magnox/Magnesium	NE
Nickel	
Titanium	
Uranium	
Zinc	NE
Zircaloy/Zirconium	NE
Other metals	NE

Organics (%wt): -

	(%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	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.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	~100.0	Cs-treat - Potassium hexacyanocobalt (II)-ferrate (II) 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		

Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	
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

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Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l RS drum (0mm Pb)	100.0	0.36	0.36	< 1

Container type comment: Packaged into 1 MOSAIK T/ISAR IP-2.

Range in container waste volume: Single resin bed per MOSAIK

Other information on containers: -

Conditioned density (t/m^3): 0.11

Conditioned density comment: The bulk density of the waste is calculated using the total waste mass and volume of the wastestream.

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

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: -

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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	1.40E+01	C C 2			Gd 153		8		
Be 10	5.34E-05	C C 2			Ho 163	8.7E-08	C C 2		
C 14	2.19E-01	C C 2			Ho 166m	7.41E-09	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	4.95E-08	C C 2		
Cl 36	2.12E-02	C C 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	6.66E-02	C C 2			Pt 193		8		
Mn 53		8			Tl 204	6.81E-03	C C 2		
Mn 54	1.87E-07	C C 2			Pb 205		8		
Fe 55	8.31E-02	C C 2			Pb 210	7.92E-08	C C 2		
Co 60	4.25E-03	C C 2			Bi 208	1.88E-02	C C 2		
Ni 59	7.72E-03	C C 2			Bi 210m	4.39E-09	C C 2		
Ni 63	4.92E-01	C C 2			Po 210	5.11E-05	C C 2		
Zn 65	8.45E-08	C C 2			Ra 223		8		
Se 79	4.46E-06	C C 2			Ra 225	3.35E-08	C C 2		
Kr 81		8			Ra 226	5.58E-07	C C 2		
Kr 85	3.42E-02	C C 2			Ra 228		8		
Rb 87		8			Ac 227	1.64E-02	C C 2		
Sr 90	5.58E-02	C C 2			Th 227		8		
Zr 93	3.84E-05	C C 2			Th 228	3.4E-07	C C 2		
Nb 91		8			Th 229	4E-08	C C 2		
Nb 92		8			Th 230	1.85E-06	C C 2		
Nb 93m	2E-05	C C 2			Th 232	4.16E-07	C C 2		
Nb 94	2.63E-04	C C 2			Th 234	4.4E-09	C C 2		
Mo 93	3.05E-06	C C 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	1.94E-04	C C 2			U 232	1.08E-05	C C 2		
Ru 106	6.99E-06	C C 2			U 233	7.18E-05	C C 2		
Pd 107	2.2E-06	C C 2			U 234	1.66E-05	C C 2		
Ag 108m	4.14E-02	C C 2			U 235	3.4E-07	C C 2		
Ag 110m	1.75E-08	C C 2			U 236	1.85E-06	C C 2		
Cd 109	3.16E-07	C C 2			U 238	6.4E-06	C C 2		
Cd 113m	6.58E-02	C C 2			Np 237	7.68E-04	C C 2		
Sn 119m	1.88E-09	C C 2			Pu 236	6.71E-08	C C 2		
Sn 121m	5.07E-03	C C 2			Pu 238	7.36E-03	C C 2		
Sn 123		8			Pu 239	2.34E-02	C C 2		
Sn 126	9.68E-06	C C 2			Pu 240	2.83E-02	C C 2		
Sb 125	1.3E-03	C C 2			Pu 241	1.63E-01	C C 2		
Sb 126	1.35E-06	C C 2			Pu 242	1.73E-04	C C 2		
Te 125m	3.25E-04	C C 2			Am 241	3.50E-02	C C 2		
Te 127m		8			Am 242m	5.48E-05	C C 2		
I 129	4.15E-07	C C 2			Am 243	2.09E-05	C C 2		
Cs 134	1.47E-03	C C 2			Cm 242	2.88E-02	C C 2		
Cs 135	1.16E-05	C C 2			Cm 243	4.61E-04	C C 2		
Cs 137	4.20E-03	C C 2			Cm 244	4.03E-04	C C 2		
Ba 133	1.16E-03	C C 2			Cm 245	1.39E-08	C C 2		
La 137	6.29E-07	C C 2			Cm 246	1.04E-09	C C 2		
La 138		8			Cm 248		8		
Ce 144	3.03E-07	C C 2			Cf 249		8		
Pm 145	6.94E-04	C C 2			Cf 250		8		
Pm 147	2.84E-03	C C 2			Cf 251		8		
Sm 147	4.53E-09	C C 2			Cf 252		8		
Sm 151	3.73E-03	C C 2			Other a				
Eu 152	1.43E-03	C C 2			Other b/g				
Eu 154	2.86E-03	C C 2			**Total a**	**<1.25E-01**	**C C 3**	**0**	
Eu 155	8.87E-04	C C 2			**Total b/g**	**<1.53E+01**	**C C 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