

WASTE STREAM	9B84/C	FED Magnox - Secondary Granular Activated Carbon (GAC)
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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.....	1.2 m ³	3.8 m ³
Total future arisings:		0 m ³	0 m ³
Total waste volume:		1.2 m ³	3.8 m ³
Number of waste packages in stock:	At 1.4.2019.....	3 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 Granulated Activated Carbon (GAC) originates from the abatement of FED-dissolution plant discharges.

PHYSICAL CHARACTERISTICS

General description: Spent GAC that forms part of the FED effluent activity abatement.
 Physical components (%wt): -
 Sealed sources: -
 Bulk density (t/m³): ~0.5
 Comment on density: The bulk density of the waste ranges from 0.3 to 0.7 t/m³. The average is ~0.5 t/m³. This assumes that density is for materials within the abatement modules. This estimate is based on generic specifications for GAC and is not design specific.

CHEMICAL COMPOSITION

General description and components (%wt): GAC material accounts for ~100% wt of which 35% is absorbed water. Other minor items/components ~1% wt are not assessed.
 Chemical state: Neutral
 Chemical form of radionuclides: H-3: Most tritium is expected to be present as water but some may be present in the inorganic compounds or as organic compounds.
 C-14: Carbon 14 may be present as graphite
 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):

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 metals content has not been fully assessed.

Organics (%wt):

Proprietary ion exchange resins are present. There is no oil or grease.

Total cellulosics..... NE

Paper, cotton..... NE

Wood..... NE

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 0

Fuel.....

Asphalt/Tarmac (cont.coal tar)...

Asphalt/Tarmac (no coal tar)....

Bitumen.....

Others.....

Other organics..... ~1.0

Other materials (%wt):

These figures relate only to the assumed composition of the sludge and ion exchange material. The composition of the modules has not been included. The figure quoted for graphite is present as activated carbon.

Inorganic ion exchange materials. 0

Inorganic sludges and flocs..... 1.0

Soil..... 0

Brick/Stone/Rubble..... 0

Cementitious material..... 0

Sand.....

Glass/Ceramics..... 0

Graphite..... 100.0

Granulated Activated Carbon (GAC).

Desiccants/Catalysts.....

Asbestos..... 0

Non/low friable.....

Moderately friable.....

Highly friable.....

Free aqueous liquids..... <1.0

Free non-aqueous liquids..... TR

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	Powder/Ash.....	0
Inorganic anions (%wt):	-	
	Fluoride.....	NE
	Chloride.....	NE
	Iodide.....	NE
	Cyanide.....	0
	Carbonate.....	NE
	Nitrate.....	<1.0
	Nitrite.....	NE
	Phosphate.....	NE
	Sulphate.....	NE
	Sulphide.....	NE

Materials of interest for waste acceptance criteria:

There might be trace quantities of biological material.

	Combustible metals.....	<1.0
	Low flash point liquids.....	0
	Explosive materials.....	0
	Phosphorus.....	0
	Hydrides.....	0
	Biological etc. materials.....	TR
	Biodegradable materials.....	
	Putrescible wastes.....	0
	Non-putrescible wastes.....	
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	NE
	Reacting with water.....	<1.0
	Active particles.....	
	Soluble solids as bulk chemical compounds.....	

Hazardous substances / non hazardous pollutants:

	-
	Acrylamide.....
	Benzene.....
	Chlorinated solvents.....
	Formaldehyde.....
	Organometallics.....
	Phenol.....
	Styrene.....
	Tri-butyl phosphate.....
	Other organophosphates.....
	Vinyl chloride.....
	Arsenic.....

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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):

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	0.397	0.397	3

Container type comment: -
 Range in container waste volume: Not yet determined
 Other information on containers: The container material is cast iron.
 Conditioned density (t/m³): -
 Conditioned density comment: -
 Other information on conditioning: -

RADIOACTIVITY

Source: Contaminated effluent which passes through the column will be filtered by the GAC. Contamination by fission products, actinides and activation products.
 Uncertainty: The fingerprints are conservative upper limits based upon the mass and activity of FED

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Definition of total alpha and total beta/gamma:	processed through GAC columns. Totals shown on table of radionuclide activities are the sums of the listed alpha or 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	<5.15E+00	E 3			Gd 153		8		
Be 10	<1.66E-05	D 3			Ho 163	<1.82E-06	D 3		
C 14	<6.81E-02	D 3			Ho 166m	<2.31E-09	D 3		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	<2.82E-05	D 3		
Cl 36	<6.59E-03	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	<2.04E-02	D 3			Pt 193		8		
Mn 53		8			Tl 204	<1.87E-03	D 3		
Mn 54	<6.16E-07	D 3			Pb 205		8		
Fe 55	<1.59E-02	D 3			Pb 210	<2.91E-08	D 8		
Co 60	8.01E-03	BB 1			Bi 208		8		
Ni 59	<8.77E-04	D 3			Bi 210m		8		
Ni 63	<5.71E-02	D 3			Po 210	<2.65E-08	D 3		
Zn 65	<1.67E-07	D 3			Ra 223		8		
Se 79	<1.39E-06	D 3			Ra 225	<1.25E-08	D 3		
Kr 81		8			Ra 226	<1.73E-07	D 3		
Kr 85	<1.29E-02	D 3			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	<1.81E-02	D 3			Th 227		8		
Zr 93	<7.66E-06	D 3			Th 228	<3.02E-06	D 3		
Nb 91		8			Th 229	<1.27E-08	D 3		
Nb 92		8			Th 230	<1.48E-09	D 3		
Nb 93m	<5.18E-06	D 3			Th 232		8		
Nb 94	<8.18E-05	D 3			Th 234	<3.08E-06	D 3		
Mo 93	<9.48E-07	D 3			Pa 231		8		
Tc 97		8			Pa 233	<4.35E-07	D 3		
Tc 99	<6.02E-05	D 3			U 232	<3.34E-06	D 3		
Ru 106	<1.71E-05	D 3			U 233	<2.23E-05	D 3		
Pd 107	<6.82E-07	D 3			U 234	<3.08E-06	D 3		
Ag 108m	<9.33E-03	D 3			U 235	<6.29E-08	D 3		
Ag 110m	<8.19E-08	D 3			U 236	<5.75E-07	D 3		
Cd 109	<5.05E-07	D 3			U 238	<3.08E-06	D 3		
Cd 113m	<2.37E-02	D 3			Np 237	<4.35E-07	D 3		
Sn 119m	<7.80E-09	D 3			Pu 236	<2.28E-09	D 3		
Sn 121m	<1.64E-03	D 3			Pu 238	<5.68E-04	D 3		
Sn 123		8			Pu 239	<2.03E-03	D 3		
Sn 126	<3.01E-06	D 3			Pu 240	<2.02E-03	D 3		
Sb 125	<8.57E-04	D 3			Pu 241	<1.06E-02	D 3		
Sb 126	<4.22E-07	D 3			Pu 242	<2.68E-06	D 3		
Te 125m	<2.15E-04	D 3			Am 241	<2.99E-03	D 3		
Te 127m		8			Am 242m	<2.75E-05	D 3		
I 129	<1.29E-07	D 3			Am 243	<6.53E-06	D 3		
Cs 134	<1.25E-03	D 3			Cm 242	<1.97E-05	D 3		
Cs 135	<3.60E-06	D 3			Cm 243	<4.82E-05	D 3		
Cs 137	8.91E-03	BB 1			Cm 244	<4.40E-05	D 3		
Ba 133	<4.41E-04	D 3			Cm 245	<4.33E-09	D 3		
La 137	<1.96E-07	D 3			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	<1.29E-06	D 3			Cf 249		8		
Pm 145	<2.43E-04	D 3			Cf 250		8		
Pm 147	<1.95E-03	D 3			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	<1.15E-03	D 3			Other a				
Eu 152	<4.35E-04	D 3			Other b/g				
Eu 154	<1.01E-03	D 3			Total a	<7.77E-03	D 3	0	
Eu 155	<3.3E-04	D 3			Total b/g	<5.42E+00	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