

<b>WASTE STREAM</b>	<b>9B84/C</b>	<b>FED Magnox - Secondary Granular Activated Carbon (GAC)</b>
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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.....	0.8 m <sup>3</sup>	3.9 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>	0 m <sup>3</sup>
Total waste volume:		0.8 m <sup>3</sup>	3.9 m <sup>3</sup>
Number of waste packages in stock:	At 1.4.2022.....	3 package(s)	

Comment on volumes: Volume determined 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 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: The waste does not contain sealed sources.  
 Bulk density (t/m<sup>3</sup>): ~0.82  
 Comment on density: The bulk density of the waste is calculated using the total mass and volume of the wastestream.

**CHEMICAL COMPOSITION**

General description and components (%wt): GAC material accounts for ~100% wt of which 35% is absorbed water.  
 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): -

	(%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.....	0
Nickel.....	
Titanium.....	
Uranium.....	
Zinc.....	NE
Zircaloy/Zirconium.....	NE
Other metals.....	NE

Organics (%wt):                      Proprietary ion exchange resins are present. There is no oil or grease.

	(%wt)	Type(s) and comment	% of total C14 activity
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 .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	~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.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	100.0	Granulated Activated Carbon (GAC) - CN-400-20.	100.0
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: There might be trace quantities of biological material.

(%wt) Type(s) and comment

Combustible metals..... NE

Low flash point liquids..... 0

Explosive materials..... 0

Phosphorus..... 0

Hydrides..... 0

Biological etc. materials..... TR

Biodegradable materials..... 0

Putrescible wastes..... 0

Non-putrescible wastes.....

Corrosive materials..... 0

Pyrophoric materials..... 0

Generating toxic gases..... NE

Reacting with water..... NE

Higher activity particles.....

Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants: -

(%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):      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**

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Container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	500 l RS drum (0mm Pb)	100.0	0.255	0.255	3

Container type comment: Packaged into 3 MOSAIK T/ISAR IP-2.

Range in container waste volume: Single resin bed per MOSAIK

Other information on containers: The container material is cast iron.

Conditioned density (t/m<sup>3</sup>): 0.82

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

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 processed through GAC columns.

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/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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	6.25E+00	CC 2			Gd 153		8		
Be 10	2.39E-05	CC 2			Ho 163	3.89E-08	CC 2		
C 14	9.79E-02	CC 2			Ho 166m	3.31E-09	CC 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	2.21E-08	CC 2		
Cl 36	9.47E-03	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	2.98E-02	CC 2			Pt 193		8		
Mn 53		8			Tl 204	3.05E-03	CC 2		
Mn 54	8.37E-08	CC 2			Pb 205		8		
Fe 55	3.72E-02	CC 2			Pb 210	3.54E-08	CC 2		
Co 60	2.33E-02	CC 2			Bi 208	8.43E-03	CC 2		
Ni 59	3.45E-03	CC 2			Bi 210m	1.96E-09	CC 2		
Ni 63	2.20E-01	CC 2			Po 210	2.29E-05	CC 2		
Zn 65	3.78E-08	CC 2			Ra 223		8		
Se 79	1.99E-06	CC 2			Ra 225	1.5E-08	CC 2		
Kr 81		8			Ra 226	2.5E-07	CC 2		
Kr 85	1.53E-02	CC 2			Ra 228		8		
Rb 87		8			Ac 227	7.32E-03	CC 2		
Sr 90	2.49E-02	CC 2			Th 227		8		
Zr 93	1.72E-05	CC 2			Th 228	1.52E-07	CC 2		
Nb 91		8			Th 229	1.79E-08	CC 2		
Nb 92		8			Th 230	8.27E-07	CC 2		
Nb 93m	8.94E-06	CC 2			Th 232	1.86E-07	CC 2		
Nb 94	1.17E-04	CC 2			Th 234	1.97E-09	CC 2		
Mo 93	1.36E-06	CC 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	8.67E-05	CC 2			U 232	4.84E-06	CC 2		
Ru 106	3.13E-06	CC 2			U 233	3.21E-05	CC 2		
Pd 107	9.83E-07	CC 2			U 234	7.44E-06	CC 2		
Ag 108m	1.85E-02	CC 2			U 235	1.52E-07	CC 2		
Ag 110m	7.8E-09	CC 2			U 236	8.27E-07	CC 2		
Cd 109	1.41E-07	CC 2			U 238	2.86E-06	CC 2		
Cd 113m	2.94E-02	CC 2			Np 237	3.43E-04	CC 2		
Sn 119m		8			Pu 236	3E-08	CC 2		
Sn 121m	2.27E-03	CC 2			Pu 238	3.29E-03	CC 2		
Sn 123		8			Pu 239	1.04E-02	CC 2		
Sn 126	4.33E-06	CC 2			Pu 240	1.27E-02	CC 2		
Sb 125	5.8E-04	CC 2			Pu 241	7.31E-02	CC 2		
Sb 126	6.06E-07	CC 2			Pu 242	7.74E-05	CC 2		
Te 125m	1.45E-04	CC 2			Am 241	1.57E-02	CC 2		
Te 127m		8			Am 242m	2.45E-05	CC 2		
I 129	1.85E-07	CC 2			Am 243	9.35E-06	CC 2		
Cs 134	6.58E-04	CC 2			Cm 242	1.29E-02	CC 2		
Cs 135	5.17E-06	CC 2			Cm 243	2.06E-04	CC 2		
Cs 137	3.58E-02	CC 2			Cm 244	1.8E-04	CC 2		
Ba 133	5.21E-04	CC 2			Cm 245	6.22E-09	CC 2		
La 137	2.81E-07	CC 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	1.36E-07	CC 2			Cf 249		8		
Pm 145	3.10E-04	CC 2			Cf 250		8		
Pm 147	1.27E-03	CC 2			Cf 251		8		
Sm 147	2.03E-09	CC 2			Cf 252		8		
Sm 151	1.67E-03	CC 2			Other a				
Eu 152	6.38E-04	CC 2			Other b/g				
Eu 154	1.28E-03	CC 2			<b>Total a</b>	<b>5.58E-02</b>	<b>CC 2</b>	<b>0</b>	
Eu 155	3.96E-04	CC 2			<b>Total b/g</b>	<b>6.90E+00</b>	<b>CC 2</b>	<b>0</b>	

**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