WASTE STREAM 9B83/C Graphite Filter Dust Pots

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.....	1.7 m^3	9.2 m^3
Total future arisings:		0 m^3	0 m^3
Total waste volume:		1.7 m^3	9.2 m^3
Number of waste packages in stock:	At 1.4.2022.....	7 package(s)	

Comment on volumes: volume calculated based on each package being 55% full.

Uncertainty factors on volumes:

Stock (upper):	x 1.2	Arisings (upper)	x
Stock (lower):	x 0.8	Arisings (lower)	x

WASTE SOURCE

The waste was produced in the by-pass filters, located on the reactor gas circuits. The graphite dust (and rust fragments) in the gas circuit were deposited into the by-pass filter catch pots, which were in-turn decanted into plastic bags within the interim storage filter dust pots, which were constructed from 8 inch nominal bore carbon steel pipe fittings. Sand arose from filter units in the Pond Water Treatment Plant (PWTP) - formerly known as 9B65.

PHYSICAL CHARACTERISTICS

General description:	Graphite dust originates from the by-pass filter units, where graphite dust was removed from the reactor primary gas circuits. The dust also contains fragments of rust from the reactor pressure vessel internals. This was co-packaged with sand from filter units in the Pond Water Treatment Plant (PWTP) into 7 MOSAIKs.
Physical components (%wt):	Graphite dust (23 wt%), contained in carbon steel fabricated interim storage pots (15 wt%) and plastic drums (1 wt%), and sand (61 wt%) co-packaged in 7 MOSAIKs.
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m^3):	2
Comment on density:	Density is based on known waste mass for each package and voidage calculations to obtain the volume for each waste package.

CHEMICAL COMPOSITION

General description and components (%wt):	Graphite dust (23 wt%), contained in carbon steel fabricated interim storage pots (15 wt%) and plastic drums (1 wt%), and sand (61 wt%) co-packaged in 7 MOSAIKs.
Chemical state:	-
Chemical form of radionuclides:	-
Metals and alloys (%wt):	Carbon steel fabricated interim storage graphite filter dust pots (15.41wt%).

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	15.4	carbon steel fabricated interim storage pots	
Iron.....			
Aluminium.....	0		
Beryllium.....			
Cobalt.....			

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Copper	0
Lead	0
Magnox/Magnesium	0
Nickel	
Titanium	
Uranium	
Zinc	0
Zircaloy/Zirconium	0
Other metals	0

Organics (%wt): Confirmed presence of plastic drums.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	0		
Paper, cotton	0		
Wood	0		
Halogenated plastics	0		
Total non-halogenated plastics	1.0		
Condensation polymers	0		
Others	1.0	Plastic drums	
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): Filter pots copackaged with contaminated sand and graphite dust stored in filter pots.

	(%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	60.9	Contaminated sand originating from waste stream 9B65.	
Glass/Ceramics	0		
Graphite	22.7	Graphite dust stored in filter pots.	
Desiccants/Catalysts			

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Asbestos	0
Non/low friable	
Moderately friable	
Highly friable	
Free aqueous liquids	0
Free non-aqueous liquids	0
Powder/Ash	TR

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	0	
Reacting with water	0	
Higher activity particles		
Soluble solids as bulk chemical compounds		

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide		

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Benzene.....

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: Yes. Carbon Steel filter pot is DI, conditioned using AVDS

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	0.24	0.24	7

Container type comment: -

Range in container waste volume: -

Other information on containers: -

Conditioned density (t/m^3): 2.0

Conditioned density comment: Based upon voidage calculations and known waste mass.

Other information on conditioning: -

RADIOACTIVITY

Source: Contamination by graphite from primary circuit and the filtering of active material from pond water using sand filters.

Uncertainty: Specific activities of all 7 waste packages were determined using gamma spectroscopy and fingerprints. The values quoted are based on 2012 and 2013 characterisation data, scaled to Co-60 content of each waste package and summed to output waste stream total. Decayed to 01/04/2022.

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: Specific activities of all 7 waste packages were measured and derived using gamma spectroscopy and the application of fingerprints. Decayed from 2013 by nine years to 01/04/2022.

Other information: Specific activity is a function of operating history. Activities given are based on the graphite dust (without accounting for the mass of the carbon steel pot).

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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	1.72E-03	C C 2			Gd 153		8		
Be 10	3.66E-09	C C 2			Ho 163		8		
C 14	3.97E-03	C C 2			Ho 166m	2.41E-06	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	1.84E-04	C C 2			Lu 174		8		
Ar 39	2.37E-06	C C 2			Lu 176		8		
Ar 42		C C 2			Hf 178n	4.06E-06	C C 2		
K 40	3.52E-08	C C 2			Hf 182		8		
Ca 41	2.09E-04	C C 2			Pt 193	8.84E-04	C C 2		
Mn 53		C C 2			Tl 204	1.28E-06	C C 2		
Mn 54		8			Pb 205		8		
Fe 55	2.70E-03	C C 2			Pb 210		8		
Co 60	7.19E-03	C C 2			Bi 208	8.22E-04	C C 2		
Ni 59	1.45E-04	C C 2			Bi 210m		8		
Ni 63	1.02E-02	C C 2			Po 210	2.78E-07	C C 2		
Zn 65		8			Ra 223		8		
Se 79	8.14E-09	C C 2			Ra 225		8		
Kr 81	1.69E-08	C C 2			Ra 226		8		
Kr 85	1.62E-04	C C 2			Ra 228		8		
Rb 87		8			Ac 227	7.83E-04	C C 2		
Sr 90	5.51E-04	C C 2			Th 227		8		
Zr 93	1.81E-06	C C 2			Th 228	1.53E-08	C C 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	5.64E-08	C C 2		
Nb 93m	3.67E-06	C C 2			Th 232	2.24E-08	C C 2		
Nb 94	7.01E-06	C C 2			Th 234		8		
Mo 93	9.15E-06	C C 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	1.38E-04	C C 2			U 232	1.57E-09	C C 2		
Ru 106		8			U 233	4.10E-09	C C 2		
Pd 107	1.99E-08	C C 2			U 234	5.23E-07	C C 2		
Ag 108m	1.05E-03	C C 2			U 235	1.53E-08	C C 2		
Ag 110m		8			U 236	5.64E-08	C C 2		
Cd 109		8			U 238	5.94E-08	C C 2		
Cd 113m	6.14E-07	C C 2			Np 237	2.93E-05	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	5.57E-06	C C 2			Pu 238	7.15E-05	C C 2		
Sn 123		8			Pu 239	7.26E-05	C C 2		
Sn 126	7.39E-08	C C 2			Pu 240	1.16E-04	C C 2		
Sb 125	8.31E-08	C C 2			Pu 241	3.08E-03	C C 2		
Sb 126	1.03E-08	C C 2			Pu 242	1.58E-06	C C 2		
Te 125m	2.08E-08	C C 2			Am 241	4.84E-04	C C 2		
Te 127m		8			Am 242m	1.89E-07	C C 2		
I 129	1.42E-05	C C 2			Am 243	1.91E-07	C C 2		
Cs 134	2.18E-06	C C 2			Cm 242	4.00E-04	C C 2		
Cs 135	1.49E-07	C C 2			Cm 243	4.10E-07	C C 2		
Cs 137	1.12E-02	C C 2			Cm 244	4.98E-06	C C 2		
Ba 133	7.15E-05	C C 2			Cm 245		8		
La 137	4.28E-08	C C 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	6.22E-09	C C 2			Cf 250		8		
Pm 147	2.80E-07	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	4.67E-04	C C 2			Other a				
Eu 152	5.52E-05	C C 2			Other b/g				
Eu 154	4.56E-05	C C 2			**Total a**	**1.18E-03**	**C C 2**	**0**	
Eu 155	1.57E-04	C C 2			**Total b/g**	**4.58E-02**	**C C 2**	**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