WASTE STREAM 9G04/C Ion Exchange Material Conditioned Waste

SITE	Trawsfynydd
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW; PFSD
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	312.2 m^3	1374.1 m^3
Total future arisings:		0 m^3	0 m^3
Total waste volume:		312.2 m^3	1374.1 m^3
Number of waste packages in stock:	At 1.4.2022.....	411 package(s)	

Comment on volumes: The volume of waste packaged in type 1803C drums is 312.2 m3. There will be no further arisings of this waste stream.

Uncertainty factors on volumes:

Stock (upper):	x 1.0	Arisings (upper)	x
Stock (lower):	x 1.0	Arisings (lower)	x

WASTE SOURCE Ion exchange materials retrieved from storage tanks (resin vault 2) and solidified in the solidification plant at Trawsfynydd.

PHYSICAL CHARACTERISTICS

General description: Conditioned ion exchange material in packages originally intended for sea dumping. The packages (411) are type 1803C. Each is of gross weight about 2.5 t and contains approximately 0.3 m3 of conditioned ion exchange material. The total volume of the raw material packaged was about 60 m3. Drums are 0.9 m diameter x 1.2 m high. Waste conditioning was carried out during 1985. The packages each weigh about 2.5 t and so require suitable lifting equipment.

Physical components (%wt): Ion exchange material (5.7% wt), polymer and iron grit (6.6% wt), water (2.4 % wt), mild steel (1.7% wt), iron shot (74.8% wt), cement paste/grout (8.8% wt).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): 3.2

Comment on density: Density of waste is 1.2 t/m3. Density of packaged waste is 3.2 t/m3.

CHEMICAL COMPOSITION

General description and components (%wt): The ion exchange material has been conditioned by mixing with DOW WSB 101 polymer. Packaging and conditioning was carried out in 1985 with a neoprene rubber gasket being incorporated into each drum. On average each package contains proprietary ion exchange materials (including a little sand) (5.7% wt), iron grit and DOW polymer (6.6% wt), water (2.4% wt), mild steel (1.7% wt), iron shot (74.8% wt), cement paste/grout (8.8% wt). Ion exchange material types are:- Lewatit DN ~0.8% wt, Zerolit 225 ~0.5% wt, IRA400 ~0.1% wt, IRN78L ~1.2% wt, Decalso Y ~1.5%wt, AW500 ~1.2%. Sand is ~0.4% wt.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Chemical form of tritium has not been determined but is likely to be water or as other inorganic or as organic compounds.
C-14: The carbon 14 content is insignificant.
Cl-36: The chlorine 36 content is insignificant.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
Ra: The radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: The uranium isotope content is insignificant.
Np: The neptunium content is insignificant.
Pu: Chemical form of plutonium isotopes may be plutonium oxides.

Metals and alloys (%wt): Mild steel liners and reinforcing bars are present.

WASTE STREAM 9G04/C Ion Exchange Material Conditioned Waste

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	~1.7	The packaging includes mild steel liners, mild steel reinforcing bars, the mild steel mixing paddle and a grout capping layer. Mild steel makes up 1.7% of the filled packages by weight, iron shot 74.8% (by wt), and iron grit about 0.5% by weight.	
Iron	~75.3	The conditioned waste incorporates iron grit. The packaging includes iron shot in the concrete. Iron shot makes up 74.8% of the packages (by wt), and iron grit about 0.5% by weight.	
Aluminium	0		
Beryllium	0		
Cobalt			
Copper	0		
Lead	0		
Magnox/Magnesium	0		
Nickel			
Titanium			
Uranium			
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	0		

Organics (%wt): Proprietary ion exchange resins and DOW polymer are present. The DOW polymer is a mixed polymer formed mainly by addition polymerisation but with some condensation cross-linking. The total wt% has been assigned to condensation polymers in the table.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	0		
Paper, cotton	0		
Wood	0		
Halogenated plastics	0		
Total non-halogenated plastics	6.1		
Condensation polymers	6.1		
Others	0		
Organic ion exchange materials	~2.6		
Total rubber	TR		
Halogenated rubber	TR	Neoprene.	
Non-halogenated rubber			
Hydrocarbons			
Oil or grease			
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			

WASTE STREAM 9G04/C Ion Exchange Material Conditioned Waste

Bitumen	
Others	
Other organics	0

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	~2.7		
Inorganic sludges and flocs	0		
Soil	0		
Brick/Stone/Rubble	0		
Cementitious material	~8.8		
Sand	~0.40		
Glass/Ceramics	0		
Graphite	0		
Desiccants/Catalysts			
Asbestos	0		
Non/low friable			
Moderately friable			
Highly friable			
Free aqueous liquids	2.4		
Free non-aqueous liquids	0		
Powder/Ash	0		

Inorganic anions (%wt): Inorganic anions are assessed as 0% wt apart from any which may be present in the 8.8 wt% of cementitious grout/cement paste. These have not been assessed.

	(%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: No materials likely to pose a fire or other non-radiological hazard have been identified.

	(%wt)	Type(s) and comment
Combustible metals	0	
Low flash point liquids	0	
Explosive materials	0	
Phosphorus	0	

WASTE STREAM 9G04/C Ion Exchange Material Conditioned Waste

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: None expected

	(%wt)	Type(s) and comment
Acrylamide		
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		

WASTE STREAM 9G04/C Ion Exchange Material Conditioned Waste

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

Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
4m box (200mm concrete shielding)	100.0	4.55	10.9	69

Container type comment: The 1803C packages are expected to be the disposal containers. Should over packing be required, a 4mILW box could be used. This conditioning factor converts the current volume of waste in 4m boxes assuming 6 drums per box.

Range in container waste volume: Six type 1803 drums could be held in each 4m box.

Other information on containers: The 4m ILW box will be made of stainless steel.

Conditioned density (t/m^3): 2.5

Conditioned density comment: Should conditioning be required, the density of the wasteform is estimated to be approximately 2.5 t/m3. The wasteform is taken as being 6 type 1803 drums conditioned in the available volume in a 4m box.

Other information on conditioning: The original conditioned package is the type 1803C drum of approximately 760 litre overall volume. The waste was originally prepared for sea-dumping.

RADIOACTIVITY

Source: Conditioned used ion exchange resins arising from the treatment of pond and effluent water. Contamination by fission products is the main source of activity. Some actinides are also present.

Uncertainty: The range of uncertainty on the beta/gamma activity is about 10-15% and on the alpha activity 20%.

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: The assigned radioactivity has been determined from plant operating records supported by sampling and analysis of the raw resin prior to conditioning. The quoted activities are based upon declared activities of the raw waste at March 1983 with allowance for subsequent decay, and growth of Am241 from Pu241. The volume of the packaging has been taken into account in calculating the activities.

Other information: -

WASTE STREAM 9G04/C Ion Exchange Material Conditioned Waste

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	1.39E-05	B B 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	3.35E-07	B B 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	1.06E-08	B B 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	1.40E-08	B B 2			Pb 210		8		
Co 60	1.49E-07	B B 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63	1.40E-06	B B 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	2.12E-03	B B 2			Th 227		8		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m		8			Th 232		8		
Nb 94		8			Th 234	4.83E-08	B B 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	7.49E-06	B B 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	3.72E-08	B B 2		
Ag 108m		8			U 235	5.23E-09	B B 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	4.83E-08	B B 2		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	8.07E-06	B B 2		
Sn 123		8			Pu 239	8.32E-06	B B 2		
Sn 126		8			Pu 240	1.04E-05	B B 2		
Sb 125	4.39E-09	B B 2			Pu 241	1.87E-04	B B 2		
Sb 126		8			Pu 242		8		
Te 125m	1.1E-09	B B 2			Am 241	2.15E-05	B B 2		
Te 127m		8			Am 242m		8		
I 129	1.40E-08	B B 2			Am 243		8		
Cs 134	3.87E-07	B B 2			Cm 242		8		
Cs 135		8			Cm 243	1.45E-08	B B 2		
Cs 137	2.08E-02	B B 2			Cm 244	1.85E-07	B B 2		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	4.82E-08	B B 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		8			Other a				
Eu 152		8			Other b/g				
Eu 154	4.85E-07	B B 2			**Total a**	**4.85E-05**	**B B 2**	**0**	
Eu 155	5.25E-08	B B 2			**Total b/g**	**2.31E-02**	**B B 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