WASTE STREAM 9G19/C Ion Exchange Material - Conditioned Waste

SITE	Trawsfynydd
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	215.0 m^3	946.3 m^3
Total future arisings:		0 m^3	0 m^3
Total waste volume:		215.0 m^3	946.3 m^3
Number of waste packages in stock:	At 1.4.2019.....	283 package(s)	

Comment on volumes: No future arisings. The volume of waste packaged in type 1803C drums is 215.0 m3. There are 283 drums.

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 (campaigns 4, 6 & 7).

PHYSICAL CHARACTERISTICS

General description: Conditioned ion exchange material in packages originally intended for sea dumping. The packages (283) are type 1803C. Each is of gross weight about 2.5 t and contains approximately 0.76 m3 of conditioned ion exchange material. Drums are 0.9 m diameter x 1.2 m high. 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: -

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 which is contaminated with both fission products and actinides, has been conditioned by mixing with DOW WSB 101 polymer. Conditioning was performed in three distinct campaigns between 2004 and 2012. Packaging and conditioning was carried out 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: Proprietory ion exchange material including mainly Lewatit DN and AW500, the remainder consists of IRA 74, ARC 359, IE95, IRN78L and cation resin. At least 32% of the ion exchange resins are organic in nature (principally phenol formaldehyde based). The remainder are inorganic materials.

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 chemical form of selenium has not been determined.
Tc-99: The chemical form of technetium has not been determined.
Ra: The radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: The uranium isotope content is insignificant.
Np: The chemical form of neptunium has not been determined.
Pu: Chemical form of plutonium isotopes may be plutonium oxides.

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

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	Stainless steel	0	
	Other ferrous metals	~1.7	The packaging includes mild steel liners, iron shot in the concrete, 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.
	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.		
	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	~1.9	
	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)		
	Bitumen		
	Others		
	Other organics	0	
Other materials (%wt):	-		

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Inorganic ion exchange materials.	~3.8
Inorganic sludges and flocs.....	TR
Soil.....	0
Brick/Stone/Rubble.....	0
Cementitious material.....	~8.8
Sand.....	
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.

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.

Combustible metals.....	0
Low flash point liquids.....	0
Explosive materials.....	0
Phosphorus.....	0
Hydrides.....	0
Biological etc. materials.....	0
Biodegradable materials.....	
Putrescible wastes.....	0
Non-putrescible wastes.....	
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0

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Active particles.....

Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants: None expected.

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

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): No

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... 0

PACKAGING AND CONDITIONING

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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	48

Container type comment: The type of container to be used is under review.

Range in container waste volume: No significant variability is expected.

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

Conditioned density (t/m^3): 2.5

Conditioned density comment: The density of the wasteform is estimated to be approximately 2.5 t/m3. The wasteform is taken as being 6 type 1803 drums packaged 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. Currently it is anticipated that the drums will be overpacked in a 4m ILW box before being consigned to a repository.

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: Specific activity is a function of Station operating history. Values were derived from available measurements. The values quoted are indicative of the activities that might be expected.

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 in 2002 with allowance for subsequent decay. The volume of the packaging has been taken into account in calculating the activities.

Other information: -

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	9.42E-05	B B 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	1.45E-06	B B 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	4.59E-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	6.11E-07	B B 2			Pb 210		8		
Co 60	1.96E-06	B B 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63	6.37E-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	1.1E-02	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	9.01E-08	B B 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	3.23E-05	B B 2			U 232		8		
Ru 106	2.13E-05	B B 2			U 233		8		
Pd 107		8			U 234	1.6E-07	B B 2		
Ag 108m		8			U 235	2.26E-08	B B 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	2.09E-07	B B 2		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	3.7E-05	B B 2		
Sn 123		8			Pu 239	3.6E-05	B B 2		
Sn 126		8			Pu 240	4.48E-05	B B 2		
Sb 125	1.88E-07	B B 2			Pu 241	1.18E-03	B B 2		
Sb 126		8			Pu 242		8		
Te 125m	8.9E-07	B B 2			Am 241	8.13E-05	B B 2		
Te 127m		8			Am 242m		8		
I 129	6.04E-08	B B 2			Am 243		8		
Cs 134	4.01E-05	B B 2			Cm 242		8		
Cs 135		8			Cm 243	7.46E-08	B B 2		
Cs 137	1.07E-01	B B 2			Cm 244	1.08E-06	B B 2		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	3.95E-06	B B 2			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	2.36E-06	B B 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.98E-06	B B 2			Other a				
Eu 152		8			Other b/g	1.6E-08	B B 2		
Eu 154	4.04E-06	B B 2			**Total a**	**2.01E-04**	**B B 2**	**0**	
Eu 155	7.71E-07	B B 2			**Total b/g**	**1.19E-01**	**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