WASTE STREAM 9G16/C Sludge - Conditioned Material

SITE	Trawsfynydd
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.....	~61.6 m³	73.1 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		61.6 m³	73.1 m³
Number of waste packages in stock:	At 1.4.2022.....	28 package(s)	

Comment on volumes: There are 28 drums.

Uncertainty factors on volumes:

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

WASTE SOURCE Sludge retrieved from the main sludge vault and solidified in the solidification plant at Trawsfynydd.

PHYSICAL CHARACTERISTICS

General description:	Conditioned sludge in 3m3 stainless steel drum waste packages.
Physical components (%wt):	Sludge (7 wt%), cementitious grout (62 wt%), package furniture (29 wt%) and bound oil (2 wt%).
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m³):	1.89
Comment on density:	The density was calculated from the conditioned wasteform mass and volume reported in the Periodic Review (LL31196039 Issue 1).

CHEMICAL COMPOSITION

General description and components (%wt): Sludge (7 wt%), cementitious grout (62 wt%), package furniture (29 wt%) and bound oil (2 wt%).

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 form of other inorganic compounds or as organic compounds.
C-14: Carbon may be present as graphite.
Cl-36: The chemical form of chlorine 36 has not been assessed.
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: Traces of thorium may be present in its natural form or as insoluble salts.
U: The chemical form of uranium isotopes has not been determined but may be uranium oxides.
Np: The chemical form of neptunium has not been determined.
Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Stainless steel liners are present.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	29.0	Stainless steel liners and package furniture are present, Grade 316S11.	
Other ferrous metals.....			
Iron.....			
Aluminium.....	0		

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Beryllium	0	
Cobalt		
Copper	0	
Lead	0	
Magnox/Magnesium	0	
Nickel		
Titanium		
Uranium		
Zinc	0	
Zircaloy/Zirconium	0	
Other metals	NE	Not fully assessed.

Organics (%wt): There are no halogenated plastics or rubbers present.

	(%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	0.28	Lewatit DN	
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	2.0	Bound oil	

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	NE		
Inorganic sludges and flocs	7.0		
Soil	NE		
Brick/Stone/Rubble	NE		
Cementitious material	62.0	9:1 BFS/OPC immobilisation matrix.	
Sand			
Glass/Ceramics	NE		

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Graphite	NE
Desiccants/Catalysts	
Asbestos	0
Non/low friable	
Moderately friable	
Highly friable	
Free aqueous liquids	NE
Free non-aqueous liquids	NE
Powder/Ash	0

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
Fluoride	0	
Chloride	NE	
Iodide	0	
Cyanide	0	
Carbonate	NE	
Nitrate	0	
Nitrite	0	
Phosphate	0	
Sulphate	NE	
Sulphide	0	

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	NE	
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	NE	
Higher activity particles		
Soluble solids as bulk chemical compounds		

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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.....		
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	

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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
3m^3 drum	100.0	2.2	2.2	28

Container type comment: The waste has been conditioned.

Range in container waste volume: The waste loading per package is not expected to vary significantly.

Other information on containers: The container material is stainless steel.

Conditioned density (t/m^3): 1.89

Conditioned density comment: The density was calculated from the conditioned wasteform mass and volume reported in the Periodic Review (LL31196039 Issue 1).

Other information on conditioning: The waste has been conditioned.

RADIOACTIVITY

Source: Contaminated sludge. Contamination by fission products, actinides and activation products.

Uncertainty: Specific activity is a function of Station operating history.

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 specific activities have been derived using the radionuclide inventory of the main sludge vault and the known wastestream package mass and volume.

Other information: -

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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	9.99E-04	C C 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	3.07E-04	C C 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	7.02E-07	C C 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	8.27E-06	C C 2			Pb 210		8		
Co 60	1.93E-04	C C 2			Bi 208		8		
Ni 59	9.71E-06	C C 2			Bi 210m		8		
Ni 63	3.91E-04	C C 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	2.50E-02	C C 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	7.83E-08	C C 2			Th 234	9.03E-06	C C 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	7.92E-08	C C 2		
Tc 99	4.24E-05	C C 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	6.93E-06	C C 2		
Ag 108m	2.84E-06	C C 2			U 235	3.77E-08	C C 2		
Ag 110m		8			U 236	2E-07	C C 2		
Cd 109		8			U 238	9.03E-06	C C 2		
Cd 113m		8			Np 237	7.99E-08	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	2.79E-03	C C 2		
Sn 123		8			Pu 239	5.05E-03	C C 2		
Sn 126		8			Pu 240	6.57E-03	C C 2		
Sb 125	3.87E-07	C C 2			Pu 241	7.53E-02	C C 2		
Sb 126		8			Pu 242		8		
Te 125m	9.7E-08	C C 2			Am 241	2.12E-02	C C 2		
Te 127m		8			Am 242m		8		
I 129	2.14E-09	C C 2			Am 243		8		
Cs 134	3.58E-08	C C 2			Cm 242		8		
Cs 135		8			Cm 243	9.22E-06	C C 2		
Cs 137	1.47E-02	C C 2			Cm 244	1.71E-04	C C 2		
Ba 133	5.79E-07	C C 2			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	1.56E-05	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.33E-03	C C 2			Other a				
Eu 152	3.96E-06	C C 2			Other b/g				
Eu 154	3.38E-04	C C 2			**Total a**	**3.59E-02**	**C C 2**	**0**	
Eu 155	3.21E-05	C C 2			**Total b/g**	**1.19E-01**	**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