WASTE STREAM 2C05 Sludge

SITE	Chapelcross
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	Yes

WASTE VOLUMES

		Reported		
Stocks:	At 1.4.2022.....	~19.0 m³		
Total future arisings:		0 m³		
Total waste volume:		19.0 m³		
Comment on volumes:	Sludge is stored under water.			
Uncertainty factors on volumes:	Stock (upper): x 1.2		Arisings (upper)	x
	Stock (lower): x 0.8		Arisings (lower)	x

WASTE SOURCE The sludge arises from the corrosion of fuel cladding.

PHYSICAL CHARACTERISTICS

General description:	The waste is a sludge which arises from the corrosion of Magnox fuel cladding. There are no items which require special handling.
Physical components (%vol):	Sludge (100%).
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m³):	1.3
Comment on density:	The defined mean density refers to the mass divided by the volume as stored.

CHEMICAL COMPOSITION

General description and components (%wt):	Magnesium hydroxide; water; traces of uranium.
Chemical state:	Alkali
Chemical form of radionuclides:	H-3: Tritium may be present as tritiated water. C-14: Carbon-14 may be present as graphite. Cl-36: 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: Present in metallic and reacted forms. Np: The neptunium content is insignificant. Pu: Present in metallic and mixed oxide forms.
Metals and alloys (%wt):	-

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	0		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....			
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	P		

WASTE STREAM 2C05 Sludge

Nickel		
Titanium		
Uranium		
Zinc	0	
Zircaloy/Zirconium	0	
Other metals	TR	Small pieces of uranium.

Organics (%wt): Organic materials are unlikely to be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	0		
Paper, cotton	0		
Wood	0		
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): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	0		
Inorganic sludges and flocs	~100.0		
Soil	0		
Brick/Stone/Rubble	0		
Cementitious material	0		
Sand			
Glass/Ceramics	0		
Graphite	0		
Desiccants/Catalysts			
Asbestos	0		
Non/low friable			
Moderately friable			

WASTE STREAM 2C05 Sludge

Highly friable.....	
Free aqueous liquids.....	P
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): Not fully assessed. Oxides and hydroxides are present.

	(%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	
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: Probably no toxic metals present except for small pieces of uranium.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		

WASTE STREAM 2C05 Sludge

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):

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....		
Total complexing agents.....	NE	

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

Conditioning method:	drying of waste into Mosaiks using AVDS
Plant Name:	-
Location:	Chapelcross
Plant startup date:	-

WASTE STREAM 2C05 Sludge

Total capacity (m^3/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m^3/y incoming waste): -

Other information: -

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l RS drum (0mm Pb)	100.0	0.865	0.49	22

Likely container type comment: -

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix:

Other information: -

Conditioned density (t/m^3): 0.6

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

RADIOACTIVITY

Source: The material is contaminated with Sr-90, Cs-137, Am-241 and various isotopes of plutonium.

Uncertainty: -

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 activity estimates are based on sampling.

Other information: -

WASTE STREAM 2C05 Sludge

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		6			Gd 153		8		
Be 10		8			Ho 163		8		
C 14		6			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36		8			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	1.20E-07	B D 1			Pb 205		8		
Fe 55		5			Pb 210		8		
Co 60	8.27E-03	B D 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63		8			Po 210		8		
Zn 65	1.59E-09	B D 1			Ra 223		8		
Se 79		4			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	6.75E-02	B D 1			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		4		
Nb 94		8			Th 234		8		
Mo 93		8			Pa 231		4		
Tc 97		8			Pa 233	3.44E-08	B D 2		
Tc 99		8			U 232		8		
Ru 106	7.82E-07	B D 1			U 233		8		
Pd 107		8			U 234		8		
Ag 108m		8			U 235		8		
Ag 110m		8			U 236		8		
Cd 109		8			U 238		8		
Cd 113m		8			Np 237	3.47E-08	B D 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	4.64E-08	B D 2		
Sn 123		8			Pu 239		7		
Sn 126		8			Pu 240		7		
Sb 125		8			Pu 241		8		
Sb 126		8			Pu 242		8		
Te 125m		8			Am 241	8.83E-03	B D 1		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	3.56E-05	B D 2			Cm 242		8		
Cs 135		8			Cm 243		5		
Cs 137	6.06E-02	B D 2			Cm 244		5		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	4.68E-08	B D 1			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147		4			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		4			Other a				
Eu 152		8			Other b/g				
Eu 154	7.58E-04	B D 1			**Total a**	**8.83E-03**	**B D 2**	**0**	
Eu 155	3.62E-04	B D 1			**Total b/g**	**1.38E-01**	**B D 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