WASTE STREAM 2D76/C Encapsulated Retrieved Pond Sludge

SITE	Sellafield
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Sellafield Limited
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	0.5 m³	0.6 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		0.5 m³	0.6 m³
Number of waste packages in stock:	At 1.4.2022.....	1 package(s)	

Comment on volumes: Future arisings are not reported to avoid double counting with stream 2D95.1 FGMSP pond and bay sludge (stocks only) and 2D95.5 SPP1 buffer store (stocks only). 2D76/C is the treatment stream with arisings from 2022. Projected arisings of 2D76/C are estimated to be 472m3 per year (1,000 drums per year) over period 2022/23 - 2033/34 (total 5,664m3). Single trial drum for encapsulation of pond sludges produced to date.

Uncertainty factors on volumes:

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

WASTE SOURCE The degradation of Magnox fuel during pond storage results in the generation of magnesium hydroxide sludge in the pond. Sludge retrieved from the pond for encapsulation.

PHYSICAL CHARACTERISTICS

General description: The waste is a sludge comprising magnesium hydroxide contaminated with irradiated fuel, which has been encapsulated in a cement matrix. This waste has been encapsulated in cement in a 500 litre drum. It will be stored in an interim engineered store prior to final disposal to a repository.

Physical components (%wt): 30% sludge; 70% Ground granulated blast furnace slag / ordinary Portland cement grout.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): NE

Comment on density: This was processed in the same manner using the same ratio of powder mixing as current slurry drums, weight when drum weighed before sentencing to store is consistent with other slurry waste streams.

CHEMICAL COMPOSITION

General description and components (%wt): Magnesium hydroxide ~5%; Uranium ~0.13%; Water ~25%; Cement ~70%.

Chemical state: Alkali

Chemical form of radionuclides:
C-14: Carbonate.
Cl-36: Present as trace amount of clathrate compounds of metallic salts readily lost to aqueous solution.
Se-79: Not estimated.
Tc-99: Not estimated.
I-129: Present as trace amount of clathrate metallic salt compounds readily lost to aqueous solution.
Ra: None declared in product spec.
Th: Not estimated.
U: As metal oxide
Np: Not estimated.
Pu: Not estimated.

Metals and alloys (%wt): No sheet metal present.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	TR		
Iron			
Aluminium			
Beryllium	<0.01		
Cobalt	0		
Copper			
Lead	0		
Magnox/Magnesium	0		
Nickel			
Titanium	NE		
Uranium	0.13		
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	~0		

Organics (%wt): -

	(%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): -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	5.0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	94.9		
Sand.....	0	Sand not present in encapsualtion grout.	
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	0	None present in this waste.	
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): -

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

Materials of interest for waste acceptance criteria: None known.

	(%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.....		

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Corrosive materials.....	P	Encapsulation grout is strongly alkaline.
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....	0	All loose material bound in encapsulation grout.
Soluble solids as bulk chemical compounds.....	P	Some sodium and magnesium compounds.

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....	0	
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....	0	
Styrene.....		
Tri-butyl phosphate.....	0	
Other organophosphates.....		
Vinyl chloride.....	0	
Arsenic.....	0	
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	0	
Caesium.....		
Selenium.....	0	
Chromium.....	TR	
Molybdenum.....	0	
Thallium.....		
Tin.....	TR	
Vanadium.....	0	
Mercury compounds.....		
Others.....	0	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		
EEE Type 2.....		
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		

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Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….	0	
Other organic complexants.....	0	
Total complexing agents.....	0	

Potential for the waste to contain discrete items: No.

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum	100.0	0.472	0.472	1

Container type comment: -

Range in container waste volume: -

Other information on containers: 500 litre stainless steel drum.

Conditioned density (t/m^3): ~2.0

Conditioned density comment: -

Other information on conditioning: -

RADIOACTIVITY

Source: The waste is pond sludge from long term storage of irradiated fuel. It is composed of corroded fuel and fuel cladding material.

Uncertainty: The data is based on sample data from pre-consigned waste route fingerprint. Future arisings expected to be significantly different as solids loadings optimised.

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 supernate and sludge samples were analysed and the derived data combined.

Other information: Nb95 8.78E-07, Zr95 1.93E-05, Ru103 8.42E-05, Sr89 1.91E-05, C14 1.49E-05.

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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	5.65E-05	B B 2			Gd 153				
Be 10					Ho 163				
C 14					Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	1.39E-09	B B 2			Pb 205				
Fe 55					Pb 210				
Co 60	1.77E-05	B B 2			Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65	9.30E-11	B B 2			Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	5.19E-04	B B 2			Th 227				
Zr 93					Th 228	1.93E-06	B B 2		
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99	4.39E-07	B B 2			U 232				
Ru 106	3.99E-08	B B 2			U 233				
Pd 107					U 234				
Ag 108m					U 235	1.18E-07	B B 2		
Ag 110m	1.21E-10	B B 2			U 236	5.89E-07	B B 2		
Cd 109					U 238	5.08E-06	B B 2		
Cd 113m					Np 237	6.94E-04	B B 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239	2.65E-03	B B 2		
Sn 126					Pu 240	3.58E-03	B B 2		
Sb 125	2.51E-05	B B 2			Pu 241	4.21E-02	B B 2		
Sb 126					Pu 242	3.78E-06	B B 2		
Te 125m					Am 241	9.02E-03	B B 2		
Te 127m					Am 242m				
I 129	3.31E-04	B B 2			Am 243				
Cs 134	1.43E-06	B B 2			Cm 242				
Cs 135					Cm 243				
Cs 137	5.82E-02	B B 2			Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	1.37E-09	B B 2			Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152	1.31E-04	B B 2			Other b/g				
Eu 154	1.04E-04	B B 2			**Total a**	**1.60E-02**	**B B 2**	**0**	
Eu 155	2.55E-06	B B 2			**Total b/g**	**1.02E-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