

<b>WASTE STREAM</b>	<b>2D95.1</b>	<b>Magnox Fuel Storage Pond Sludge</b>
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**SITE** Sellafield  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Sellafield Limited  
**WASTE TYPE** ILW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	1302.3 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>
Total waste volume:		1302.3 m <sup>3</sup>

Comment on volumes: No future arisings are expected. The pond is no longer an operational plant. The pond sludge volumes are only estimates based on crude sludge depth measurements taken at a number of points across the pond. No routine measurements of the sludge are taken.

Uncertainty factors on volumes: Stock (upper): x 1.3 Arisings (upper) x  
 Stock (lower): x 0.7 Arisings (lower) x

**WASTE SOURCE** The waste originates as sludge from the corrosion of Magnox cladding.

**PHYSICAL CHARACTERISTICS**

General description: Magnesium hydroxide sludge, containing quantities of corroded uranium. No items require special handling.

Physical components (%vol): Sludge (100%).

Sealed sources: Not yet determined.

Bulk density (t/m<sup>3</sup>): 1.5

Comment on density: The density has been estimated as: 1.5 t/m<sup>3</sup> wet, 2.5 t/m<sup>3</sup> dry solid.

**CHEMICAL COMPOSITION**

General description and components (%wt): Magnesium hydroxide with quantities of uranium.

Chemical state: Alkali

Chemical form of radionuclides: Ra: Present in less than trace amounts in fuel.  
 U: Present in metallic and reacted forms (oxides and possibly hydride).  
 Pu: Present in metallic and mixed oxide forms.

Metals and alloys (%wt): Metal only present as small particles.

Stainless steel.....	0
Other ferrous metals.....	0
Iron.....	
Aluminium.....	
Beryllium.....	
Cobalt.....	0
Copper.....	
Lead.....	0
Magnox/Magnesium.....	P
Nickel.....	
Titanium.....	
Uranium.....	P
Zinc.....	0
Zircaloy/Zirconium.....	0
Other metals.....	

<b>WASTE STREAM</b>	<b>2D95.1</b>	<b>Magnox Fuel Storage Pond Sludge</b>
---------------------	---------------	--

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

Total cellulose	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):

-	
Inorganic ion exchange materials	0
Inorganic sludges and flocs	100.0
Soil	0
Brick/Stone/Rubble	0
Cementitious material	TR
Sand	TR
Glass/Ceramics	
Graphite	0
Desiccants/Catalysts	
Asbestos	0
Non/low friable	
Moderately friable	
Highly friable	
Free aqueous liquids	NE
Free non-aqueous liquids	0
Powder/Ash	

Inorganic anions (%wt): Magnesium hydroxide is present.

<b>WASTE STREAM</b>	<b>2D95.1</b>	<b>Magnox Fuel Storage Pond Sludge</b>
---------------------	---------------	--

Fluoride.....	TR
Chloride.....	TR
Iodide.....	TR
Cyanide.....	
Carbonate.....	TR
Nitrate.....	TR
Nitrite.....	
Phosphate.....	TR
Sulphate.....	TR
Sulphide.....	TR

Materials of interest for waste acceptance criteria:

There are no hazardous materials in the waste except for possible traces of uranium hydride. Uranium and Magnox corrosion evolves hydrogen at slow rates in pond water.

Combustible metals.....	0
Low flash point liquids.....	0
Explosive materials.....	0
Phosphorus.....	0
Hydrides.....	
Biological etc. materials.....	0
Biodegradable materials.....	0
Putrescible wastes.....	0
Non-putrescible wastes.....	0
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Active particles.....	NE
Soluble solids as bulk chemical compounds.....	NE

Hazardous substances / non hazardous pollutants:

-	
Acrylamide.....	
Benzene.....	NE
Chlorinated solvents.....	
Formaldehyde.....	
Organometallics.....	
Phenol.....	NE
Styrene.....	
Tri-butyl phosphate.....	NE
Other organophosphates.....	
Vinyl chloride.....	NE
Arsenic.....	NE
Barium.....	
Boron.....	NE

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Cadmium..... NE  
 Caesium.....  
 Selenium..... NE  
 Chromium..... NE  
 Molybdenum..... NE  
 Thallium.....  
 Tin..... NE  
 Vanadium..... NE  
 Mercury compounds.....  
 Others..... NE  
 Electronic Electrical Equipment (EEE)  
     EEE Type 1.....  
     EEE Type 2.....  
     EEE Type 3.....  
     EEE Type 4.....  
     EEE Type 5.....

Complexing agents (%wt): Not yet determined  
 EDTA.....  
 DPTA.....  
 NTA.....  
 Polycarboxylic acids.....  
 Other organic complexants..... Unlikely to be present.  
 Total complexing agents..... 0

**PACKAGING AND CONDITIONING**

Conditioning method: The waste will be transported to SPP1 buffer and then exported to WEP for final conditioning via the Sludge handling and Export Plant (SHEP).  
 Plant Name: Sludge Packaging Plant 1  
 Location: Sellafield  
 Plant startup date: April 2016 (for buffer storage) / April 2029- Sludge Handling & Export Plant (SHEP) Ref GEN 5601A  
 Total capacity (m<sup>3</sup>/y incoming waste): -  
 Target start date for packaging this stream: -  
 Throughput for this stream (m<sup>3</sup>/y incoming waste): -  
 Other information: The waste will be stored in the Sludge Packaging Plant buffer store until the treatment plant is available.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	500 l drum	100.0	0.149	0.472	8741

<b>WASTE STREAM</b>	<b>2D95.1</b>	<b>Magnox Fuel Storage Pond Sludge</b>
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Likely container type comment: -

Range in container waste volume: -

Other information on containers: Stainless Steel

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m<sup>3</sup>): NE

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: Not yet determined

Treatment	Stream volume (%)	Comment
-	-	-

**RADIOACTIVITY**

Source: The main source of activity is mixed fission products, uranium and plutonium.

Uncertainty: The accuracy of activity for some sludges is fairly good as they have been sampled. From the best available data an overall average has been derived.

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: -

Other information: -

**WASTE STREAM 2D95.1 Magnox Fuel Storage Pond Sludge**

Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3					Gd 153				
Be 10					Ho 163				
C 14					Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36	1.04E-04	BB 2			Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210	9.44E-11	BB 2		
Co 60	4.33E-04	A 3			Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	8.66E-11	BB 2		
Zn 65					Ra 223	2.34E-09	BB 2		
Se 79	1.72E-05	BB 2			Ra 225	2.19E-13	BB 2		
Kr 81					Ra 226	5.83E-10	BB 2		
Kr 85					Ra 228				
Rb 87					Ac 227	2.36E-09	BB		
Sr 90	1.10E+01	BB 2			Th 227	2.31E-09	BB 2		
Zr 93	8.00E-04	BB 2			Th 228				
Nb 91					Th 229	2.21E-13	BB 2		
Nb 92					Th 230	1.50E-07	BB 2		
Nb 93m	4.25E-04	BB 2			Th 232	1.40E-16	BB 2		
Nb 94	5.00E-07	BB 2			Th 234	1.00E-03	BB 2		
Mo 93					Pa 231	9.91E-09	BB 2		
Tc 97					Pa 233	1.05E-05	BB 2		
Tc 99	1.30E-02	A 3			U 232				
Ru 106	4.59E-09	A 3			U 233	3.99E-10	BB 2		
Pd 107					U 234	9.17E-04	BB 2		
Ag 108m					U 235	2.60E-05	BB 2		
Ag 110m					U 236	3.14E-07	BB 2		
Cd 109					U 238	1.00E-03	BB 2		
Cd 113m					Np 237	1.06E-05	BB 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238	3.19E-01	BB 2		
Sn 123					Pu 239	4.70E-01	BB 2		
Sn 126	1.30E-04	BB 2			Pu 240	5.89E-01	BB 2		
Sb 125					Pu 241	7.69E+00	BB 2		
Sb 126	1.83E-05	BB 2			Pu 242				
Te 125m					Am 241	1.94E+00	BB 2		
Te 127m					Am 242m				
I 129	1.00E-05	BB 2			Am 243				
Cs 134	5.36E-06	BB 2			Cm 242				
Cs 135	7.00E-05	BB 2			Cm 243				
Cs 137	3.07E+00	BB 2			Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	1.75E-11	A 3			Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a	1.20E-01	BB 2		
Eu 152	7.25E-03	A 3			Other b/g	2.06E-19	BB 2		
Eu 154	3.54E-02	A 3			<b>Total a</b>	<b>3.44E+00</b>	<b>BB 2</b>	<b>0</b>	
Eu 155	4.35E-03	A 3			<b>Total b/g</b>	<b>2.18E+01</b>	<b>BB 2</b>	<b>0</b>	

**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