

WASTE STREAM	2D95.2	Settling Pond Sludge
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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.....	75.0 m ³
Total future arisings:		0 m ³
Total waste volume:		75.0 m ³

Comment on volumes: The settling pond is no longer an operational plant and is currently being prepared for decommissioning. The sludge inventory will remain static. Sludge retrieval and transfer to SIXEP started in 1992 with the bulk of the sludges from the main north and south tanks being removed. The remaining sludge volumes are estimates based on sludge sump dimensions.

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

WASTE SOURCE Sludge which has settled from liquid effluents from the Magnox decanning and storage building.

PHYSICAL CHARACTERISTICS

General description: The beta/gamma active sludge has settled from liquid effluents. The particle size for fine sludge is <1700 microns, with the majority in the range 87.2 to 212 microns. Over 40% of the sludge is of particle size less than 87.2 microns. Material at outlet end of the building is significantly finer than the material in the inlet sump. No items require special handling.

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

Sealed sources: Not yet determined.

Bulk density (t/m³): 1.2

Comment on density: The waste density is 1.2 t/m³ as stored, and 0.7 t/m³ for dry settled sludge.

CHEMICAL COMPOSITION

General description and components (%wt): Magnesium hydroxide sludge. Uranium (3.4%), plutonium (0.02%). Minor constituents are Co, Ru, Sb, Cs, Ce and Eu. Moisture content 40 - 70%.

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.....	0.40
Iron.....	
Aluminium.....	0.60
Beryllium.....	
Cobalt.....	0
Copper.....	
Lead.....	0
Magnox/Magnesium.....	<<1.0
Nickel.....	
Titanium.....	
Uranium.....	P

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	Zinc.....	0
	Zircaloy/Zirconium.....	0
	Other metals.....	
Organics (%wt):	Organic materials are unlikely to be present in the waste.	
	Total cellulose.....	0
	Paper, cotton.....	
	Wood.....	
	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.....	98.0
	Soil.....	0
	Brick/Stone/Rubble.....	0
	Cementitious material.....	0
	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.	

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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 within 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): No
 EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

Organic complexing agents are unlikely to be present.

PACKAGING AND CONDITIONING

Conditioning method: The sludge will be transferred to SIXEP Bulk Storage Tanks.
 Plant Name: SIXEP Waste Packaging Plant (SWP)
 Location: Sellafield
 Plant startup date: December 2028, Ref GEN-5601A.
 Total capacity (m³/y incoming waste): -
 Target start date for packaging this stream: -
 Throughput for this stream (m³/y incoming waste): -
 Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	Sellafield 3m ³ box	100.0	~0.799	2.7	94

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Likely container type comment: Packaging plans are being developed.

Range in container waste volume: -

Other information on containers: Stainless steel

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m³): 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 is from fuel corrosion and the nuclides involved include Cs, Eu, Ru, Sr-90 and other mixed fission products and actinides.

Uncertainty: Best available.

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: -

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	8.51E-05	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	1.48E-11	BB 2		
Co 60	6.85E-05	D 3			Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	1.36E-11	BB 2		
Zn 65					Ra 223	3.60E-10	BB 2		
Se 79	3.45E-06	BB 2			Ra 225	3.30E-14	BB 2		
Kr 81					Ra 226	9.14E-11	BB 2		
Kr 85					Ra 228				
Rb 87					Ac 227	3.64E-10	BB		
Sr 90	1.64E+00	BB 2			Th 227	3.56E-10	BB 2		
Zr 93	1.00E-04	BB 2			Th 228				
Nb 91					Th 229	3.33E-14	BB 2		
Nb 92					Th 230	2.36E-08	BB 2		
Nb 93m	5.31E-05	BB 2			Th 232	2.19E-17	BB 2		
Nb 94	8.00E-08	BB 2			Th 234	1.70E-04	BB 2		
Mo 93					Pa 231	1.52E-09	BB 2		
Tc 97					Pa 233	1.59E-06	BB 2		
Tc 99	2.00E-03	D 3			U 232				
Ru 106	7.52E-10	D 3			U 233	6.02E-11	BB 2		
Pd 107					U 234	1.44E-04	BB 2		
Ag 108m					U 235	4.00E-06	BB 2		
Ag 110m					U 236	4.83E-08	BB 2		
Cd 109					U 238	1.70E-04	BB 2		
Cd 113m					Np 237	1.60E-06	BB 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238	4.92E-02	BB 2		
Sn 123					Pu 239	7.20E-02	BB 2		
Sn 126	2.17E-05	BB 2			Pu 240	9.07E-02	BB 2		
Sb 125					Pu 241	1.18E+00	BB 2		
Sb 126	3.04E-06	BB 2			Pu 242				
Te 125m					Am 241	2.93E-01	BB 2		
Te 127m					Am 242m				
I 129	2.00E-06	BB 2			Am 243				
Cs 134	8.26E-07	BB 2			Cm 242				
Cs 135	1.00E-05	BB 2			Cm 243				
Cs 137	4.75E-01	BB 2			Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	2.71E-12	D 3			Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a	2.70E-02	BB 2		
Eu 152	1.11E-03	D 3			Other b/g	3.24E-20	BB 2		
Eu 154	5.47E-03	D 3			Total a	5.33E-01	BB 2	0	
Eu 155	6.95E-04	D 3			Total b/g	3.31E+00	BB 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