

WASTE STREAM	9A80	Drummed Sludge
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SITE Berkeley
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW

WASTE VOLUMES

	Reported
Stocks: At 1.4.2019.....	3.7 m ³
Total future arisings:	0 m ³
Total waste volume:	3.7 m ³
Comment on volumes:	-
Uncertainty factors on volumes:	Stock (upper): x 1.1 Arisings (upper) x Stock (lower): x 0.8 Arisings (lower) x

WASTE SOURCE The sludge originates from routine filtration of liquid effluents and cooling pond water and from special clean-up operations on cooling ponds at Berkeley Power Station and Berkeley Centre.

PHYSICAL CHARACTERISTICS

General description: The waste consists of debris washed from persons, floors and clothing, corrosion products such as magnesium hydroxide and carbonate detached from fuel elements and extraneous materials such as flakes of paint. Also there is some filter sand. Sludge particles may be up to millimetre size, and there will probably be 50-450 kg/m³ of dry material. There are no large items that may require special handling. 200 litre drums containing the waste.

Physical components (%wt): Sludge (~90%) in 200 litre mild steel drums (~10%).

Sealed sources: -

Bulk density (t/m³): ~1.2

Comment on density: The density of sludge including the drum is estimated to be about 1.2 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Sand, magnesium hydroxide, magnesium carbonate and a range of other materials. Mild steel drums containing the waste.

Chemical state: Alkali

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 organic or inorganic compounds.
 C-14: Carbon 14 may be present as graphite.
 Cl-36: The chemical form of chlorine 36 has not been assessed.
 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: The chemical form of uranium isotopes has not been determined but may be present as uranium oxides.
 Np: The neptunium content is insignificant.
 Pu: The chemical form of plutonium isotopes has not been determined but may be present as plutonium oxides.

Metals and alloys (%wt): The waste is contained in 200l drums with walls about 1 to 2mm thick.

Stainless steel.....	NE
Other ferrous metals.....	~10.0
Iron.....	
Aluminium.....	<0.50
Beryllium.....	TR
Cobalt.....	
Copper.....	NE

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Lead..... TR
 Magnox/Magnesium..... <4.0
 Nickel.....
 Titanium.....
 Uranium.....
 Zinc..... NE
 Zircaloy/Zirconium..... NE
 Other metals..... NE

The presence of "other" metals has not been fully assessed.

Organics (%wt):

A detailed assessment of organic materials in the waste has not been made. There may be some oil and grease. Some caesium resin beads are present.

Total cellulose..... NE
 Paper, cotton..... NE
 Wood..... NE
 Halogenated plastics <1.0
 Total non-halogenated plastics..... NE
 Condensation polymers..... NE
 Others..... NE
 Organic ion exchange materials.... NE
 Total rubber..... <1.0
 Halogenated rubber <1.0
 Non-halogenated rubber..... NE
 Hydrocarbons.....
 Oil or grease
 Fuel.....
 Asphalt/Tarmac (cont.coal tar)...
 Asphalt/Tarmac (no coal tar)....
 Bitumen.....
 Others.....
 Other organics..... NE

Other materials (%wt):

-
 Inorganic ion exchange materials. NE
 Inorganic sludges and flocs..... <90.0
 Soil..... NE
 Brick/Stone/Rubble..... NE
 Cementitious material..... NE
 Sand.....
 Glass/Ceramics..... NE
 Graphite..... NE
 Desiccants/Catalysts.....
 Asbestos..... 0
 Non/low friable.....
 Moderately friable.....
 Highly friable.....

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	Free aqueous liquids.....	P
	Free non-aqueous liquids.....	P
	Powder/Ash.....	0
Inorganic anions (%wt):	The presence of inorganic anions shown in the table has not been fully assessed.	
	Fluoride.....	NE
	Chloride.....	NE
	Iodide.....	NE
	Cyanide.....	0
	Carbonate.....	5.0
	Nitrate.....	NE
	Nitrite.....	NE
	Phosphate.....	NE
	Sulphate.....	0.90
	Sulphide.....	NE
Materials of interest for waste acceptance criteria:	The waste is unlikely to present a fire hazard but this requires confirmation since Magnox may be present and will ignite under appropriate conditions. There might be trace quantities of biological material.	
	Combustible metals.....	<4.0
	Low flash point liquids.....	0
	Explosive materials.....	0
	Phosphorus.....	0
	Hydrides.....	0
	Biological etc. materials.....	TR
	Biodegradable materials.....	
	Putrescible wastes.....	0
	Non-putrescible wastes.....	
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	NE
	Reacting with water.....	<4.0
	Active particles.....	
	Soluble solids as bulk chemical compounds.....	
Hazardous substances / non hazardous pollutants:	-	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	
	Styrene.....	
	Tri-butyl phosphate.....	
	Other organophosphates.....	

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Vinyl chloride.....
 Arsenic.....
 Barium.....
 Boron.....
 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
 EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... TR

PACKAGING AND CONDITIONING

Conditioning method: Waste currently stored in DCIC, to be conditioned in 2018/19
 Plant Name: -
 Location: Berkeley Site
 Plant startup date: -
 Total capacity (m³/y incoming waste): -
 Target start date for packaging this stream: -
 Throughput for this stream (m³/y incoming waste): -
 Other information: Waste currently stored in DCIC, to be conditioned in 2018/19

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Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	3m ³ RS box	100.0	1.85	2.5	2

Likely container type comment: -

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: Other information: -

Conditioned density (t/m³): -

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing:

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source: Sludge contaminated by fission products and activation products including actinides.

Uncertainty: Specific activity is a function of Station operating history. The values are indicative of the activities that might be expected.

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 values quoted were derived by extrapolation from available measurements.

Other information: -

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Drummed Sludge

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	1.53E-04	CC 2			Gd 153		8		
Be 10	2E-08	CC 2			Ho 163		8		
C 14	4.00E-04	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26	5E-06	CC 2			Tm 171		8		
Cl 36	2E-05	CC 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	3E-06	CC 2			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	4.22E-06	CC 2			Pb 210		8		
Co 60	6.18E-05	CC 2			Bi 208		8		
Ni 59	3E-06	CC 2			Bi 210m		8		
Ni 63	4.60E-04	CC 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1.72E-08	CC 2			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	1.50E-02	CC 2			Th 227		8		
Zr 93	6E-07	CC 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	3.57E-07	CC 2			Th 232		8		
Nb 94		8			Th 234	2E-06	CC 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	9E-06	CC 2		
Tc 99	2E-07	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107	3E-08	CC 2			U 234	1.00E-06	CC 2		
Ag 108m	9.80E-09	CC 2			U 235	<5E-08	C 3		
Ag 110m		8			U 236	2.00E-07	CC 2		
Cd 109		8			U 238	2E-06	CC 2		
Cd 113m	1.1E-07	CC 2			Np 237	9E-06	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m	8.53E-04	CC 2			Pu 238	2.73E-04	CC 2		
Sn 123		8			Pu 239	7.00E-04	CC 2		
Sn 126	8.7E-08	CC 2			Pu 240	7.00E-04	CC 2		
Sb 125	4.34E-08	CC 2			Pu 241	1.69E-03	CC 2		
Sb 126	1.22E-08	CC 2			Pu 242	6E-07	CC 2		
Te 125m	1.09E-08	CC 2			Am 241	4.36E-04	CC 2		
Te 127m		8			Am 242m	3.76E-06	CC 2		
I 129	9E-09	CC 2			Am 243	2.00E-06	CC 2		
Cs 134	7.12E-08	CC 2			Cm 242	3.11E-06	CC 2		
Cs 135	2E-06	CC 2			Cm 243	5.3E-06	CC 2		
Cs 137	1.51E-01	CC 2			Cm 244	3.17E-06	CC 2		
Ba 133		8			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	2.09E-06	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	7.29E-05	CC 2			Other a				
Eu 152	1.62E-06	CC 2			Other b/g				
Eu 154	7.58E-05	CC 2			Total a	2.13E-03	CC 2	0	
Eu 155	5.51E-06	CC 2			Total b/g	1.7E-01	CC 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