

<b>WASTE STREAM</b>	<b>9A77</b>	<b>BPS Sludge in Drums</b>
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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.....	13.5 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>
Total waste volume:		13.5 m <sup>3</sup>

Comment on volumes: Station operation ceased in March 1989. This waste was accumulated between 1965 and 1978. There will be no further arisings of this waste stream. The volume split between this stream and stream 9A71 was revised prior to the 2004 Inventory in accord with a Project Team judgement that some waste formerly in stream 9A77 may be ILW.

Uncertainty factors on volumes:	Stock (upper):	x 1.2	Arisings (upper)	x
	Stock (lower):	x 0.9	Arisings (lower)	x

**WASTE SOURCE** The sludge originates from routine filtration of liquid effluents and cooling pond water.

**PHYSICAL CHARACTERISTICS**

General description: This waste arose from the routine filtration of liquid effluent and cooling pond water. The waste consists of corrosion products such as magnesium hydroxide and carbonate detached from fuel elements and extraneous materials such as flakes of paint. There will also be drain debris, asbestos fibre and other materials used as a precoat material. Some of the sludge drums will contain cotton socks, used for filtration purposes and PVC bags. This waste stream was originally classified as LLW, however it is not possible to distinguish between the caesium sludge (9A71 and 72) and this waste and so it will all be processed as ILW. The waste drums form part of 9A916 and will be processed as MCI waste. There are no large items that may require special handling. The sludge cans have approximate dimensions 890 mm long x 305 mm diameter.

Physical components (%vol): The waste consists of 100% sludge from the Active Effluent Treatment Plant.

Sealed sources: -

Bulk density (t/m<sup>3</sup>): ~1.1

Comment on density: -

**CHEMICAL COMPOSITION**

General description and components (%wt): The waste contains magnesium hydroxide, magnesium carbonate, water and a range of other materials, including ammonium molybdenum phosphate and potentially asbestos, which was used as a pre-coat. The solids content of the sludge is unknown as it varies from container to container. The slurry may vary from 'toothpaste' to water in constituency. Asbestos, cellulose and other precoat materials will probably account for <0.25wt%. The cotton socks and PVC bags will be removed and will form part of the BPS MCI waste stream (9A36-38). The waste can is included in waste stream 9A916.

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 inorganic compounds or as organic compounds.  
C-14: Carbon 14 will probably be present as graphite.  
Cl-36: Chlorine 36 will probably be present as chloride.  
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: Chemical form of U isotopes has not been determined but may be oxides.  
Np: The neptunium content is insignificant.  
Pu: Chemical form of Pu isotopes has not been determined but may be oxides.

Metals and alloys (%wt): Any metal present will be as finely divided material. There is no sheet or bulk metal.

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

Magnox will not be present except possibly in trace quantities.

Nimonic

The waste is contained within thick steel drums which when removed will form part of the 9A916 waste stream.

**Organics (%wt):**

A number of sludge drums will contain cotton socks, which were used as filters. The socks were originally placed in PVC bags before being placed in the steel drums, however it is not known which drums they were disposed of in. There may also be some oil or grease present in the sludge.

Total cellulose.....	NE
Paper, cotton.....	NE
Wood.....	0
Halogenated plastics .....	0
Total non-halogenated plastics.....	0
Condensation polymers.....	0
Others.....	0
Organic ion exchange materials....	NE
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.....	NE

**Other materials (%wt):**

Graphite is expected in at least trace quantities.

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Inorganic ion exchange materials.	NE
Inorganic sludges and flocs.....	~98.0
Soil.....	0
Brick/Stone/Rubble.....	0
Cementitious material.....	0
Sand.....	
Glass/Ceramics.....	0
Graphite.....	TR
Desiccants/Catalysts.....	
Asbestos.....	<0.25
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	P
Free non-aqueous liquids.....	NE
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.....	NE
Nitrate.....	NE
Nitrite.....	NE
Phosphate.....	NE
Sulphate.....	NE
Sulphide.....	NE

## Materials of interest for waste acceptance criteria:

A number of the drums may contain hydrogen, due either to radiolytic degradation of the water or corrosion of the steel drum. This may pressurise the containers. It is anticipated that the solids will have settled out from the water phase and compacted to some degree.

Combustible metals.....	TR
Low flash point liquids.....	0
Explosive materials.....	NE
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.....	TR

**WASTE STREAM****9A77****BPS Sludge in Drums**Hazardous substances /  
non hazardous pollutants:

Active particles.....

Soluble solids as bulk chemical  
compounds.....

None expected.

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

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:

This stream is to be co-packaged with 9A37, 9A38, 9A57, 9A58, 9A59, 9A65, 9A68,  
9A69, 9A70, 9A71, 9A72, 9A75, 9A78, 9A82. Packages are assigned to 9A68,

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9A71 & 9A75.

Plant Name: -  
 Location: Berkeley Site  
 Plant startup date: -  
 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: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages

Likely container type comment: -  
 Range in container waste volume: -  
 Other information on containers: -  
 Likely conditioning matrix:  
 Other information: -  
 Conditioned density (t/m<sup>3</sup>): -  
 Conditioned density comment: -  
 Other information on conditioning: -  
 Opportunities for alternative disposal routing:

Treatment	Stream volume (%)	Comment
-	-	-

**RADIOACTIVITY**

Source: Sludge resulting from the treatment of pond and effluent waters and contaminated by fission products and activation products including actinides.  
 Uncertainty: Specific activity is a function of Station operating history. The values quoted 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: Values were derived by extrapolation from available data.  
 Other information: -

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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	1.53E-05	CC 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	3.00E-07	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	2E-08	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-05	C 3			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	<1.87E-08	C 3			Pb 210		8		
Co 60	2.06E-06	CC 2			Bi 208		8		
Ni 59	<6E-07	C 3			Bi 210m		8		
Ni 63	5.52E-05	CC 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1E-07	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-03	CC 2			Th 227		8		
Zr 93	1E-06	CC 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	5.75E-07	CC 2			Th 232		8		
Nb 94		8			Th 234	2E-07	CC 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	<6E-06	C 3		
Tc 99	5E-06	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	2.00E-07	CC 2		
Ag 108m	<9.80E-08	C 3			U 235	<1E-08	C 3		
Ag 110m		8			U 236	2E-07	CC 2		
Cd 109		8			U 238	2E-07	CC 2		
Cd 113m		8			Np 237	<6E-06	C 3		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	4.58E-05	CC 2		
Sn 123		8			Pu 239	7.00E-05	CC 2		
Sn 126	2E-07	CC 2			Pu 240	1.00E-04	CC 2		
Sb 125	<4.85E-09	C 3			Pu 241	1.13E-03	CC 2		
Sb 126	<2.8E-08	C 3			Pu 242	6E-07	CC 2		
Te 125m	<1.21E-09	C 3			Am 241	4.22E-04	CC 2		
Te 127m		8			Am 242m	3.76E-06	CC 2		
I 129	1E-08	CC 2			Am 243	1.00E-06	CC 2		
Cs 134		8			Cm 242	3.11E-06	CC 2		
Cs 135	6E-08	CC 2			Cm 243	5.3E-08	CC 2		
Cs 137	5.30E-03	CC 2			Cm 244	4.42E-07	CC 2		
Ba 133		8			Cm 245	1.00E-07	CC 2		
La 137		8			Cm 246	1.00E-07	CC 2		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	1.68E-08	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	4.55E-05	CC 2			Other a				
Eu 152	1.07E-03	CC 2			Other b/g				
Eu 154	7.58E-06	CC 2			<b>Total a</b>	<b>6.50E-04</b>	<b>CC 2</b>	<b>0</b>	
Eu 155	1.28E-07	CC 2			<b>Total b/g</b>	<b>9.17E-03</b>	<b>CC 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