

<b>WASTE STREAM</b>	<b>9A916</b>	<b>Empty BPS Sludge Cans</b>
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**SITE** Berkeley

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** LLW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2021.....	95.3 m <sup>3</sup>
Total future arisings:		95.3 m <sup>3</sup>
Total waste volume:		95.3 m <sup>3</sup>

Comment on volumes: The waste occurs when sludge cans are emptied of their contents.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.2  
 Stock (lower): x Arisings (lower) x 0.8

**WASTE SOURCE** Mild steel sludge cans that will be emptied of sludge during Station decommissioning (see waste streams 9A71, 9A72, 9A77 and 9A78).

**PHYSICAL CHARACTERISTICS**

General description: The waste comprises Sludge Cans (305mm dia x 890mm height). The top of the can has a 3" filling penetration that is closed with a 3" BSP taper threaded plug. The containers are assumed to be emptied of their waste content prior to conditioning. The containers are thick walled (6.4mm thick base and 4.8mm thick walls) and are expected to be corroded to a lesser extent than the containers in 9A917. Some residual internal and external contamination is anticipated. There are no large items that may require special handling. Activity estimates indicate that it is LLW.

Physical components (%wt): Empty mild steel sludge cans (~100% wt).

Sealed sources: -

Bulk density (t/m<sup>3</sup>): 0.6

Comment on density: The density range is not estimated. The density estimate assumes that the empty sludge cans are stacked tightly together.

**CHEMICAL COMPOSITION**

General description and components (%wt): Empty mild steel sludge cans. Mild steel (>99%wt), residual sludge and other contamination (<1%wt).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Most tritium is expected to be present as water but some may be in the form of other inorganic or organic compounds.  
 C-14: Carbon 14 will probably be present as graphite.  
 Cl-36: The chlorine 36 content is insignificant.  
 U: Chemical form of U isotopes has not been determined but may be oxides.  
 Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): The sludge cans are of 305 mm diameter by 890 mm height with a 6.4 mm thick base and top and 4.8 mm thick walls.

Stainless steel.....	NE
Other ferrous metals.....	>99.0
Iron.....	
Aluminium.....	0
Beryllium.....	TR
Cobalt.....	
Copper.....	0
Lead.....	0
Magnox/Magnesium.....	TR

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Nickel..... TR  
 Titanium.....  
 Uranium.....  
 Zinc..... 0  
 Zircaloy/Zirconium..... TR  
 Other metals..... TR

Nimonic

No "other" metals have been identified but there may be trace quantities.

## Organics (%wt):

There may be some residual contamination by organic material.

Total cellulose..... TR  
     Paper, cotton..... TR  
     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..... <1.0

## Other materials (%wt):

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

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	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	The presence of inorganic anions shown in the table has not been fully assessed but is expected to be <1%wt.	
	Fluoride.....	<1.0
	Chloride.....	<1.0
	Iodide.....	<1.0
	Cyanide.....	0
	Carbonate.....	<1.0
	Nitrate.....	<1.0
	Nitrite.....	<1.0
	Phosphate.....	<1.0
	Sulphate.....	<1.0
	Sulphide.....	<1.0
Materials of interest for waste acceptance criteria:	No material likely to present a fire or other non-radiological hazard has been identified. Magnox and asbestos may be present in trace quantities.	
	Combustible metals.....	TR
	Low flash point liquids.....	0
	Explosive materials.....	0
	Phosphorus.....	0
	Hydrides.....	0
	Biological etc. materials.....	0
	Biodegradable materials.....	
	Putrescible wastes.....	0
	Non-putrescible wastes.....	
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	TR
	Active particles.....	
	Soluble solids as bulk chemical compounds.....	
Hazardous substances / non hazardous pollutants:	Traces of asbestos may be present.	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	
	Styrene.....	
	Tri-butyl phosphate.....	
	Other organophosphates.....	
	Vinyl chloride.....	

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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

**TREATMENT, PACKAGING AND DISPOSAL**

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None		100.0

Comment on planned treatments:

-

**WASTE STREAM****9A916****Empty BPS Sludge Cans****Disposal Routes:**

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known	100.0

**Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):**

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known			

**Waste Packaging for Disposal:**

Container	Stream volume %	Waste loading m <sup>3</sup>	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	100.0	~7.2	14

Other information:

Loading assumed to be 7.2m<sup>3</sup> based on 36 x 0.2m<sup>3</sup> drums per HHISO, if waste compacted this could be improved.**Waste Planned for Disposal at the LLW Repository:**

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: -

Potential for the waste to contain discrete items: -

**Non-Containerised Waste for In-Vault Grouting:** (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

**WASTE STREAM****9A916****Empty BPS Sludge Cans****RADIOACTIVITY**

Source:	Empty steel sludge cans contaminated by fission products and activation products including actinides.
Uncertainty:	Specific activity is a function of Station operating history. The values quoted were derived by extrapolation from available measurements and are indicative of the activities that might be expected. Washing of the waste prior to packaging should reduce the activity levels by at least an order of magnitude. This waste will possibly be LLW or even exempt at the time of disposal, depending on the processing method.
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 specific activity was assumed to be 0.1% of the average activity of the wastes now described by streams 9A71, 9A72, 9A77 and 9A78.
Other information:	-

**WASTE STREAM**

**9A916**

**Empty BPS Sludge Cans**

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			1.82E-07	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			3E-09	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36				8	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41			<3E-07	C 3	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55			<1.01E-08	C 3	Pb 210				8
Co 60			1.53E-07	CC 2	Bi 208				8
Ni 59			<6E-09	C 3	Bi 210m				8
Ni 63			6.57E-07	CC 2	Po 210				8
Zn 65				8	Ra 223				8
Se 79				8	Ra 225				8
Kr 81				8	Ra 226				8
Kr 85				8	Ra 228				8
Rb 87				8	Ac 227				8
Sr 90			2.42E-05	CC 2	Th 227				8
Zr 93			1E-08	CC 2	Th 228				8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m			3.14E-09	CC 2	Th 232				8
Nb 94				8	Th 234		2E-09	CC 2	
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233		6E-08	CC 2	
Tc 99			5E-08	CC 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234		2.02E-09	CC 2	
Ag 108m				8	U 235				8
Ag 110m				8	U 236		2E-09	CC 2	
Cd 109				8	U 238		2E-09	CC 2	
Cd 113m				8	Np 237		<6E-08	C 3	
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		4.69E-07	CC 2	
Sn 123				8	Pu 239		7E-07	CC 2	
Sn 126			2E-09	CC 2	Pu 240		1E-06	CC 2	
Sb 125				8	Pu 241		1.94E-05	CC 2	
Sb 126				8	Pu 242		6E-09	CC 2	
Te 125m				8	Am 241		4.3E-06	CC 2	
Te 127m				8	Am 242m		4.78E-08	CC 2	
I 129				8	Am 243		1E-08	CC 2	
Cs 134				8	Cm 242		3.94E-08	CC 2	
Cs 135			2E-09	CC 2	Cm 243				8
Cs 137			2.44E-04	CC 2	Cm 244		1.42E-08	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			8.37E-09	CC 2	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151			4.66E-07	CC 2	Other a				
Eu 152			1.89E-05	CC 2	Other b/g				
Eu 154			9.69E-08	CC 2	<b>Total a</b>	<b>0</b>	<b>6.61E-06</b>	<b>CC 2</b>	
Eu 155			1.4E-08	CC 2	<b>Total b/g</b>	<b>0</b>	<b>3.09E-04</b>	<b>CC 2</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