WASTE STREAM 9B55/C Ponds Decontamination Sludge

SITE Bradwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	11.5 m³	66.0 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		11.5 m³	66.0 m³
Number of waste packages in stock:	At 1.4.2019.....	50 package(s)	
Comment on volumes:	-		
Uncertainty factors on volumes:	Stock (upper): x 1.1	Arisings (upper) x	
	Stock (lower): x 0.9	Arisings (lower) x	

WASTE SOURCE Sludge from ultra high pressure washing of the pond walls and skips and sludge accumulated at the base of the pond during operations. Sand originated from the Pond Water Treatment Plant (PWTP).

PHYSICAL CHARACTERISTICS

General description: The sludge contains flakes of paint, concrete and/or metal from the skips. The waste consists of 7.05m3 of sludge, pulverised concrete, FED and MAC debris and small waste items such as tape fragments and gloves. Some of this waste was co-packaged with sand filter waste into 50 MOSAIKs.

Physical components (%vol): Sludge consists of pond sludge (primarily magnesium hydroxide), paint and surface concrete removed from the pond walls and floor and other debris including fuel element debris and nimonic springs, as well as of the waste packages also containing sand filter waste from PWTP.

Sealed sources: -

Bulk density (t/m³): 1.6

Comment on density: This bulk density is based on measurements taken in the ponds.

CHEMICAL COMPOSITION

General description and components (%wt): Inorganic sludge (containing flakes of paint, concrete and/or metal from the skips) totalling 82.1 wt% and sand filter waste (17.9 wt%).

Chemical state: -

Chemical form of radionuclides: Pu: The chemical form of plutonium isotopes may be plutonium oxides.

Metals and alloys (%wt): None

Stainless steel.....	<1.0	
Other ferrous metals.....	<1.0	Mild steel as sludge may contain flakes of metal from the skips.
Iron.....		
Aluminium.....	0	
Beryllium.....	NE	
Cobalt.....		
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	0	
Nickel.....		

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	Titanium		
	Uranium	NE	
	Zinc	0	
	Zircaloy/Zirconium	0	
	Other metals	TR	
Organics (%wt):	The waste is an inorganic sludge whose main constituents are concrete fragments (sand or gravel sized), paint, metal fragments and bound water. The paint is most probably epoxy based. 15% "other" assumes 1mm paint over 1100m2.		
	Total cellulosics	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	~12.0	Forms part of the sludge. Paint flakes from the pond skips, likely to be epoxy based.
Other materials (%wt):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs	~44.5	
	Soil	0	
	Brick/Stone/Rubble	0	
	Cementitious material	~24.0	Forms part of the sludge
	Sand	17.9	
	Glass/Ceramics	0	
	Graphite	~1.5	Forms part of the sludge
	Desiccants/Catalysts		
	Asbestos	NE	
	Non/low friable		
	Moderately friable		
	Highly friable		
	Free aqueous liquids		

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	Free non-aqueous liquids	NE
	Powder/Ash	0
Inorganic anions (%wt):	-	
	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: No materials likely to pose a fire or other non-radiological hazard have been identified.

Combustible metals	0
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	TR
Generating toxic gases	0
Reacting with water	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	
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):

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... NE

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
500 l RS drum (0mm Pb)	100.0	0.230	0.2298	50

Container type comment: Sludge drums were put intact into MOSAIKs.

Range in container waste volume: No significant variability is expected.

Other information on containers: The container material is cast iron.

Conditioned density (t/m³): NE

Conditioned density comment: The conditioned density has not been estimated.

Other information on conditioning: -

RADIOACTIVITY

Source: Contamination from pond operations and plant operation.

Uncertainty: Specific activities of all 50 waste packages were determined using gamma spectroscopy

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	and fingerprints. The above values (Tbq/m3) are representative of the waste across the packages and each package's specific activity falls within the quoted uncertainty bands.
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:	Specific activities of all 50 waste packages were measured and derived using gamma spectroscopy and the application of fingerprints decayed by four years for RWI 2019.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	3.35E-03	C C 2			Gd 153		8		
Be 10	1.25E-08	C C 2			Ho 163	1.20E-05	C C 2		
C 14	1.47E-03	C C 2			Ho 166m	1.11E-04	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	2.64E-07	C C 2		
Cl 36	4.47E-06	C C 2			Lu 174	1.65E-08	C C 2		
Ar 39	4.81E-04	C C 2			Lu 176		8		
Ar 42	1.55E-09	C C 2			Hf 178n	1.74E-04	C C 2		
K 40	2.79E-09	C C 2			Hf 182		8		
Ca 41	1.25E-05	C C 2			Pt 193	5.13E-05	C C 2		
Mn 53		8			Tl 204	3.26E-05	C C 2		
Mn 54	1.35E-08	C C 2			Pb 205		8		
Fe 55	1.66E-02	C C 2			Pb 210		8		
Co 60	2.68E-02	B B 1			Bi 208		8		
Ni 59	7.32E-04	C C 2			Bi 210m		8		
Ni 63	3.50E-02	C C 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	3.76E-07	C C 2			Ra 225		8		
Kr 81	6.99E-08	C C 2			Ra 226		8		
Kr 85	1.10E-02	C C 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	7.08E-02	C C 2			Th 227		8		
Zr 93	6.1E-04	C C 2			Th 228	5.29E-08	C C 2		
Nb 91	1.10E-08	C C 2			Th 229		8		
Nb 92		8			Th 230	7.97E-09	C C 2		
Nb 93m	1.29E-03	C C 2			Th 232		8		
Nb 94	4.12E-06	C C 2			Th 234	1.05E-05	C C 2		
Mo 93	9.02E-06	C C 2			Pa 231		8		
Tc 97		8			Pa 233	1.25E-06	C C 2		
Tc 99	4.96E-03	C C 2			U 232	5.14E-08	C C 2		
Ru 106	4.36E-07	C C 2			U 233	1.16E-07	C C 2		
Pd 107	9.15E-07	C C 2			U 234	9.30E-06	C C 2		
Ag 108m	1.02E-05	C C 2			U 235	3.18E-07	C C 2		
Ag 110m		8			U 236	1.17E-06	C C 2		
Cd 109		8			U 238	1.05E-05	C C 2		
Cd 113m	3.84E-05	C C 2			Np 237	1.25E-06	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	5.22E-03	C C 2			Pu 238	5.95E-03	C C 2		
Sn 123		8			Pu 239	9.77E-03	C C 2		
Sn 126	3.4E-06	C C 2			Pu 240	9.69E-03	C C 2		
Sb 125	1.34E-05	C C 2			Pu 241	1.35E-01	C C 2		
Sb 126	4.76E-07	C C 2			Pu 242	4.68E-06	C C 2		
Te 125m	3.35E-06	C C 2			Am 241	3.62E-02	C C 2		
Te 127m		8			Am 242m	2.84E-05	C C 2		
I 129	2.32E-05	C C 2			Am 243	8.80E-06	C C 2		
Cs 134	9.22E-05	C C 2			Cm 242	2.36E-05	C C 2		
Cs 135	6.84E-06	C C 2			Cm 243	1.14E-05	C C 2		
Cs 137	5.79E-02	B B 1			Cm 244	1.51E-04	C C 2		
Ba 133	8.69E-06	C C 2			Cm 245	3.74E-09	C C 2		
La 137	3.53E-07	C C 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	6.72E-08	C C 2			Cf 249		8		
Pm 145	3.24E-08	C C 2			Cf 250		8		
Pm 147	7.43E-04	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.72E-03	C C 2			Other a				
Eu 152	1.90E-05	C C 2			Other b/g				
Eu 154	7.46E-04	C C 2			**Total a**	**6.19E-02**	**C C 2**	**0**	
Eu 155	1.20E-04	C C 2			**Total b/g**	**3.76E-01**	**C C 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