WASTE STREAM 9B55/C Ponds Decontamination Sludge

SITE	Bradwell
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	11.5 m^3	66.0 m^3
Total future arisings:		0 m^3	0 m^3
Total waste volume:		11.5 m^3	66.0 m^3
Number of waste packages in stock:	At 1.4.2022.....	50 package(s)	

Comment on volumes:	Volume obtained from voidage calculations.			
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 Centre Bay waste comprises pond sludge, cementitious pond wall particulates from ultra-high-pressure (UHP) water jetting operations, FED and other solid debris collected from the pond floor. Includes MAC debris and small waste items such as tape fragments and gloves. The FED is concentrated in 12 to 15 drums, with solid debris in three, and the remaining 32 to 35 containing predominantly sludge. Some of this waste was co-packaged with sand filter waste into 50 MOSAIKs.
Physical components (%wt):	Centre Bay wastes consists of sludge solids (22 wt%), Magnox FED (2 wt%), metallic debris, for example nimonic springs (2 wt%), plastic/rubber debris (<1 wt%), mild steel shielded drums (50 wt%), cement in drums (1 wt%) and sand (24 wt%).
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m^3):	2.46
Comment on density:	The bulk density is calculated from known waste mass and volume from package records.

CHEMICAL COMPOSITION

General description and components (%wt):	Centre Bay wastes consists of sludge solids (22 wt%), Magnox FED (2 wt%), metallic debris, for example nimonic springs (2 wt%), plastic/rubber debris (<1 wt%), mild steel shielded drums (50 wt%), cement in drums (1 wt%) and sand (24 wt%).
Chemical state:	-
Chemical form of radionuclides:	Pu: The chemical form of plutonium isotopes may be plutonium oxides.
Metals and alloys (%wt):	None

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	49.8	Mild steel shielded drums	
Iron.....			
Aluminium.....	0		
Beryllium.....	NE		
Cobalt.....			
Copper.....	0		

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Lead	0		
Magnox/Magnesium	1.5	Magnox FED	
Nickel			
Titanium			
Uranium	NE		
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	1.7	Metallic debris, composition unknown	

Organics (%wt): 0.2wt% plastic/rubber debris

	(%wt)	Type(s) and comment	% of total C14 activity
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	0.20	Plastic/rubber debris	

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	0		
Inorganic sludges and flocs	21.7	Sludge solids	
Soil	0		
Brick/Stone/Rubble	0		
Cementitious material	1.4	Cementitious grout	
Sand	23.7		
Glass/Ceramics	0		
Graphite	0		
Desiccants/Catalysts			
Asbestos	NE		

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Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	
Free non-aqueous liquids.....	NE
Powder/Ash.....	0

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
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.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....		
Corrosive materials.....	0	
Pyrophoric materials.....	TR	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		

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Chlorinated solvents.....	
Formaldehyde.....	
Organometallics.....	
Phenol.....	
Styrene.....	
Tri-butyl phosphate.....	
Other organophosphates.....	
Vinyl chloride.....	
Arsenic.....	
Barium.....	
Boron.....	0
Boron (in Boral).....	
Boron (non-Boral).....	
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):

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....		
Total complexing agents.....	NE	

Potential for the waste to contain discrete items: No. In & of itself not a DI; assumed not likely to contain any "rogue" items that could be.

PACKAGING AND CONDITIONING

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Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	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 50 MOSAIK T/ISAR IP-2.
Range in container waste volume:	No significant variability is expected.
Other information on containers:	The container material is cast iron.
Conditioned density (t/m^3):	2.46
Conditioned density comment:	The conditioned density is calculated from known waste mass and volume from package records.
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 and fingerprints.
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 above values (Tbq/m3) are were calculated by using the sum of individual package inventories and the volume of the wastestream. Decayed to 01/04/2022.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	2.81E-03	C C 2			Gd 153		8		
Be 10	8.82E-09	C C 2			Ho 163	7.55E-09	C C 2		
C 14	1.46E-03	C C 2			Ho 166m	1.08E-04	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	4.39E-06	C C 2			Lu 174	2.84E-09	C C 2		
Ar 39	4.74E-04	C C 2			Lu 176		8		
Ar 42	1.43E-09	C C 2			Hf 178n	1.86E-04	C C 2		
K 40	2.77E-09	C C 2			Hf 182		8		
Ca 41	1.25E-05	C C 2			Pt 193	5.27E-05	C C 2		
Mn 53		8			Tl 204	6.05E-05	C C 2		
Mn 54	1.18E-09	C C 2			Pb 205		8		
Fe 55	7.70E-03	C C 2			Pb 210		8		
Co 60	1.79E-02	C C 2			Bi 208	3.07E-02	C C 2		
Ni 59	7.29E-04	C C 2			Bi 210m		8		
Ni 63	3.41E-02	C C 2			Po 210	1.5E-05	C C 2		
Zn 65		8			Ra 223		8		
Se 79	3.67E-07	C C 2			Ra 225		8		
Kr 81	5.31E-08	C C 2			Ra 226		8		
Kr 85	8.9E-03	C C 2			Ra 228		8		
Rb 87		8			Ac 227	2.85E-02	C C 2		
Sr 90	6.52E-02	C C 2			Th 227		8		
Zr 93	6.09E-04	C C 2			Th 228	2.98E-07	C C 2		
Nb 91	1.08E-08	C C 2			Th 229		8		
Nb 92		8			Th 230	1.1E-06	C C 2		
Nb 93m	1.2E-03	C C 2			Th 232	3.16E-07	C C 2		
Nb 94	3.99E-06	C C 2			Th 234		8		
Mo 93	8.99E-06	C C 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	4.95E-03	C C 2			U 232	6.46E-08	C C 2		
Ru 106	5.5E-08	C C 2			U 233	1.1E-07	C C 2		
Pd 107	8.94E-07	C C 2			U 234	8.54E-06	C C 2		
Ag 108m	1E-05	C C 2			U 235	2.98E-07	C C 2		
Ag 110m		8			U 236	1.1E-06	C C 2		
Cd 109		8			U 238	1.83E-06	C C 2		
Cd 113m	3.23E-05	C C 2			Np 237	1.39E-03	C C 2		
Sn 119m		8			Pu 236	4.14E-09	C C 2		
Sn 121m	5.01E-03	C C 2			Pu 238	6.04E-03	C C 2		
Sn 123		8			Pu 239	6.86E-03	C C 2		
Sn 126	3.32E-06	C C 2			Pu 240	9.52E-03	C C 2		
Sb 125	6.17E-06	C C 2			Pu 241	1.59E-01	C C 2		
Sb 126	4.65E-07	C C 2			Pu 242	9.54E-05	C C 2		
Te 125m	1.55E-06	C C 2			Am 241	3.36E-02	C C 2		
Te 127m		8			Am 242m	1.21E-05	C C 2		
I 129	2.31E-05	C C 2			Am 243	8.53E-06	C C 2		
Cs 134	3.13E-05	C C 2			Cm 242	2.77E-02	C C 2		
Cs 135	6.68E-06	C C 2			Cm 243	1.01E-05	C C 2		
Cs 137	4.3E-02	C C 2			Cm 244	1.28E-04	C C 2		
Ba 133	6.86E-06	C C 2			Cm 245	3.63E-09	C C 2		
La 137	3.52E-07	C C 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	4.63E-09	C C 2			Cf 249		8		
Pm 145	2.25E-08	C C 2			Cf 250		8		
Pm 147	3.35E-04	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.71E-03	C C 2			Other a				
Eu 152	2.2E-05	C C 2			Other b/g				
Eu 154	7.06E-04	C C 2			**Total a**	**8.54E-02**	**C C 2**	**0**	
Eu 155	1.19E-04	C C 2			**Total b/g**	**4.17E-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