WASTE STREAM 5B04/C Cemented MTR Raffinate

SITE	Dounreay
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Dounreay Site Restoration Limited
WASTE TYPE	ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	2432.0 m³	2777.3 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		2432.0 m³	2777.3 m³
Number of waste packages in stock:	At 1.4.2019.....	4864 package(s)	

Comment on volumes:	There will be no further arisings.			
Uncertainty factors on volumes:	Stock (upper):	x 1.0	Arisings (upper)	x
	Stock (lower):	x 1.0	Arisings (lower)	x

WASTE SOURCE Materials Test Reactor (MTR) fuel reprocessing.

PHYSICAL CHARACTERISTICS

General description:	The waste is an anion-deficient aluminium nitrate solution, containing fission products and some actinides from reprocessing spent MTR fuel, cemented in a 9:1 BFS/OPC matrix. There are no large items in the waste. The waste has been cemented into 500 litre drums.
Physical components (%vol):	Cemented aqueous liquors (100%).
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m³):	1.95
Comment on density:	The density of the conditioned wasteform varies from 1.9 - 2.0 t/m³. The measurements were undertaken from cores taken from a full-scale inactive sample.

CHEMICAL COMPOSITION

General description and components (%wt):	The waste is composed mainly of cement containing neutralised MTR liquor. Cementitous grout (100%).
Chemical state:	Alkali
Chemical form of radionuclides:	H-3: Likely to be present, form unknown. C-14: Likely to be present, form unknown. Cl-36: Likely to be present, form unknown. Se-79: Likely to be present, form unknown. Tc-99: Likely to be present, form unknown. I-129: Likely to be present, form unknown. Ra: Likely to be present, form unknown. Th: Likely to be present, form unknown. U: Likely to be present, form unknown. Np: Likely to be present, form unknown. Pu: Likely to be present, form unknown.
Metals and alloys (%wt):	-
	Stainless steel..... 0
	Other ferrous metals..... 0
	Iron..... 0
	Aluminium..... 0
	Beryllium..... 0
	Cobalt..... 0
	Copper..... 0
	Lead..... TR
	Magnox/Magnesium..... 0

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Nickel	TR	
Titanium	0	
Uranium	0	
Zinc	0	
Zircaloy/Zirconium	0	
Other metals	<1.0	Metals are present but at trace levels within the cemented wasteform. Also includes Mercury.

Organics (%wt): The waste contains no organics. There are no halogenated plastics or rubbers present.

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	0
Oil or grease	0
Fuel	0
Asphalt/Tarmac (cont.coal tar)	0
Asphalt/Tarmac (no coal tar)	0
Bitumen	0
Others	0
Other organics	0

Other materials (%wt): -

Inorganic ion exchange materials.	0
Inorganic sludges and flocs	0
Soil	0
Brick/Stone/Rubble	0
Cementitious material	>99.0
Sand	0
Glass/Ceramics	0
Graphite	0
Desiccants/Catalysts	0
Asbestos	0
Non/low friable	0
Moderately friable	0
Highly friable	0
Free aqueous liquids	0

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	Free non-aqueous liquids	0	
	Powder/Ash	0	
Inorganic anions (%wt):	The waste contains nitrates, sulphites, sulphates, phosphates and chlorides. Other anions, such as carbonates, will be present in small quantities.		
	Fluoride	0	
	Chloride	P	
	Iodide	0	
	Cyanide	0	
	Carbonate	P	
	Nitrate	10.7	Sodium Nitrate 2.8M
	Nitrite	TR	
	Phosphate	P	
	Sulphate	P	
	Sulphide	P	
Materials of interest for waste acceptance criteria:	The waste also contains mercury, cadmium and lead at trace quantities.		
	Combustible metals	0	
	Low flash point liquids	0	
	Explosive materials	0	
	Phosphorus	TR	
	Hydrides	0	
	Biological etc. materials	0	
	Biodegradable materials	0	
	Putrescible wastes	0	
	Non-putrescible wastes	0	
	Corrosive materials	0	
	Pyrophoric materials	0	
	Generating toxic gases	0	
	Reacting with water	0	
	Active particles	0	
	Soluble solids as bulk chemical compounds	0	
Hazardous substances / non hazardous pollutants:	The waste contains mercury and trace quantities of cadmium and lead. Nickel, phosphorus and selenium may be present in trace quantities. Mercuric nitrate is present at <0.1%.		
	Acrylamide		
	Benzene	NE	
	Chlorinated solvents		
	Formaldehyde		
	Organometallics		
	Phenol	NE	
	Styrene		
	Tri-butyl phosphate	NE	
	Other organophosphates		
	Vinyl chloride	NE	

Arsenic..... NE

Barium.....

Boron..... NE

Cadmium..... TR

Caesium.....

Selenium..... TR

Chromium..... NE

Molybdenum..... NE

Thallium.....

Tin..... NE

Vanadium..... NE

Mercury compounds..... <1.0

Others..... NE

Electronic Electrical Equipment (EEE)

EEE Type 1.....

EEE Type 2.....

EEE Type 3.....

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt): No

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants..... There are no organic complexing agents present.

Total complexing agents..... 0

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum	100.0	0.5	0.5	4864

Container type comment: The waste is already conditioned.

Range in container waste volume: -

Other information on containers: -

Conditioned density (t/m^3): ~1.95

Conditioned density comment: The density of the conditioned wasteform varies from 1.9 - 2.0 t/m^3. The measurements were undertaken from cores taken from a full-scale inactive sample

Other information on conditioning: -

RADIOACTIVITY

Source: Activity arises mainly from fission products from the reprocessing of spent MTR fuel.

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Uncertainty:	The average specific activity is based on analysis of raffinate from Tanks 1, 2, 3, 4, 7, 8 and 18. FISPIN estimates were used where no analysis results were available. Tank 1 data have been used for the remaining tanks for which no assessment has been made. Analysis figures are accurate to within a factor of 3.
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:	Those radionuclides not available by analysis have been estimated from Fispin calculations.
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	5.75E-03	B B 1			Gd 153	1.14E-17	B B 2		
Be 10	1.03E-04	B B 2			Ho 163	1.11E-15	B B 2		
C 14	6.82E-06	B B 2			Ho 166m	1.08E-10	B B 2		
Na 22					Tm 170				
Al 26					Tm 171	8.85E-13	B B 2		
Cl 36	3.74E-04	B B 1			Lu 174	8.52E-21	B B 2		
Ar 39					Lu 176	7.57E-27	B B 2		
Ar 42					Hf 178n				
K 40					Hf 182	1.59E-19	B B 2		
Ca 41	2.38E-05	B B 2			Pt 193				
Mn 53					Tl 204				
Mn 54	8.71E-14	B B 2			Pb 205				
Fe 55	9.89E-07	B B 2			Pb 210	5.17E-10	B B 2		
Co 60	2.50E-04	B B 2			Bi 208				
Ni 59	1.30E-04	B B 2			Bi 210m	2.93E-25	B B 2		
Ni 63	4.78E-03	B B 2			Po 210	5.06E-10	B B 2		
Zn 65	3.49E-20	B B 2			Ra 223	3.33E-09	B B 2		
Se 79	1.86E-04	B B 2			Ra 225	1.33E-11	B B 2		
Kr 81					Ra 226	1.19E-09	B B 2		
Kr 85					Ra 228	3.44E-13	B B 2		
Rb 87	7.87E-10	B B 2			Ac 227	3.33E-09	B B 2		
Sr 90	1.01E+01	B B 1			Th 227	3.28E-09	B B 2		
Zr 93	1.40E-03	B B 2			Th 228	5.07E-10	B B 2		
Nb 91	2.56E-18	B B 2			Th 229	1.33E-11	B B 2		
Nb 92	1.54E-18	B B 2			Th 230	7.70E-08	B B 2		
Nb 93m	4.65E-03	B B 2			Th 232	3.46E-13	B B 2		
Nb 94	7.81E-04	B B 2			Th 234	2.52E-07	B B 2		
Mo 93	6.43E-03	B B 2			Pa 231	4.95E-09	B B 2		
Tc 97	4.45E-17	B B 2			Pa 233	2.47E-05	B B 2		
Tc 99	8.95E-03	B B 2			U 232	3.01E-10	B B 2		
Ru 106	1.59E-07	B B 2			U 233	5.87E-09	B B 2		
Pd 107	5.58E-06	B B 2			U 234	4.15E-05	B B 2		
Ag 108m	1.28E-11	B B 2			U 235	8.44E-07	B B 1		
Ag 110m	1.79E-15	B B 2			U 236	2.37E-06	B B 1		
Cd 109	<4.49E-06	A 3			U 238	2.52E-07	B B 1		
Cd 113m	1.49E-04	B B 2			Np 237	2.47E-05	B B 2		
Sn 119m	1.01E-15	B B 2			Pu 236	1.47E-10	B B 2		
Sn 121m	1.45E-03	B B 2			Pu 238	1.81E-02	B B 1		
Sn 123	7.08E-29	B B 2			Pu 239	2.09E-03	B B 1		
Sn 126	4.34E-05	B B 2			Pu 240	1.15E-03	B B 1		
Sb 125	8.51E-05	B B 2			Pu 241	1.84E-02	B B 1		
Sb 126	6.08E-06	B B 2			Pu 242	9.14E-07	B B 1		
Te 125m	2.13E-05	B B 2			Am 241	2.11E-02	B B 1		
Te 127m	9.19E-33	B B 2			Am 242m	7.59E-06	B B 2		
I 129	9.48E-07	B B 2			Am 243	8.92E-06	B B 2		
Cs 134	5.24E-05	B B 1			Cm 242	6.26E-06	B B 2		
Cs 135	1.79E-04	B B 2			Cm 243	1.25E-06	B B 2		
Cs 137	1.08E+01	B B 1			Cm 244	1.1E-04	B B 2		
Ba 133	2.37E-13	B B 2			Cm 245	1.77E-08	B B 2		
La 137	5.21E-12	B B 2			Cm 246	1.54E-09	B B 2		
La 138	1.36E-16	B B 2			Cm 248	5.81E-18	B B 2		
Ce 144	2.07E-10	B B 2			Cf 249	1.56E-17	B B 2		
Pm 145	4.28E-16	B B 2			Cf 250	1.54E-17	B B 2		
Pm 147	2.58E-03	B B 2			Cf 251	2.00E-19	B B 2		
Sm 147	2.96E-10	B B 2			Cf 252	7.16E-21	B B 2		
Sm 151	7.23E-02	B B 2			Other a	1.2E-14	B B 2		
Eu 152	5.16E-03	B B 2			Other b/g				
Eu 154	1.27E-02	B B 2			**Total a**	**4.26E-02**	**B B 2**	**0**	
Eu 155	1.33E-03	B B 2			**Total b/g**	**2.10E+01**	**A B 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