

WASTE STREAM	5B04/C	Cemented MTR Raffinate
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SITE Dounreay

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025		= 2432.0	2777.3
Future arisings:				0.0
Total future arisings:			0.0	0.0
Total waste volume:			2432.0	2777.3

Number of waste packages in stock: At 1.4.2025..... 4864 packages

Comment on arising rates: -

Additional information on quantities: There will be no further arisings.

Uncertainty factors on volumes: Stock (upper): x 1.00 Arisings (upper): x -
Stock (lower): x 1.00 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.

Changes since waste generated: The waste has been cemented into 500 litre drums.

Bulk density (t/m³): = 2.0

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. Cementitious grout (100%).

Chemical state: Alkali

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0	-	
Other ferrous metals.....	= 0	-	
Iron.....	= 0	-	
Aluminium.....	= 0	-	
Beryllium.....	= 0	-	
Cobalt.....	= 0	-	
Copper.....	= 0	-	
Lead.....	TR	-	
Magnox/Magnesium.....	= 0	-	
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):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 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):

	(%wt)	Type(s) and comment	% of total C14 activity
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	-	
Free non-aqueous liquids.....	= 0	-	
Powder/Ash.....	= 0	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
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:

	(%wt)	Type(s) and comment
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	-
Higher activity particles.....	= 0	-
Soluble solids as bulk chemical compounds.....	= 0	-

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	NE	-
Benzene.....	NE	-
Chlorinated solvents.....	NE	-
Formaldehyde.....	NE	-
Organometallics.....	NE	-
Phenol.....	NE	-
Styrene.....	NE	-
Tri-butyl phosphate.....	NE	-
Other organophosphates.....	NE	-
Vinyl chloride.....	NE	-
Arsenic.....	NE	-
Barium.....	NE	-
Boron.....	NE	-
Boron (in Boral).....	NE	-
Boron (non-Boral).....	NE	-
Cadmium.....	TR	-
Caesium.....	NE	-
Selenium.....	TR	-
Chromium.....	NE	-
Molybdenum.....	NE	-
Thallium.....	NE	-
Tin.....	NE	-
Vanadium.....	NE	-
Mercury compounds.....	< 1.0	-
Others.....	NE	-

Complexing agents (%wt):

No		
	(%wt)	Type(s) and comment
EDTA.....	= 0	-
DPTA.....	= 0	-
NTA.....	= 0	-
Polycarboxylic acids.....	= 0	-
Other organic complexants.....	= 0	There are no organic complexing agents present.
Total complexing agents.....	= 0	-

Physical components:

	Number	Type(s) and comment
Sources.....	= 0	-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1.....	= 0	-
EEE Type 2.....	= 0	-
EEE Type 3.....	= 0	-
EEE Type 4.....	= 0	-
EEE Type 5.....	= 0	-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction		
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application		
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None	On-site	= 100.0

Comments on planned treatments:

Waste already packed and immobilised within 500L drums. They will sit in storage on site until a final disposal location has been made available.

Conditioning method:

Waste already conditioned.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

The waste includes an inactive grout cap. LoC states: 9:1 ratio of BFS/OPC with 5 wt % additional hydrated lime

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	500 l drum (paddle)	100.0	0.50	0.50	4864	-

Range in container waste loading:

Other information on packaging and conditioning: -

Conditioned density (t/m³): ~ 2.0

Conditioned density comment: 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

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	= 100.0		
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

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

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.

Measurement of radioactivities: Those radionuclides not available by analysis have been estimated from FISPIN calculations

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.

WASTE STREAM		5B04/C		Cemented MTR Raffinate					
Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	= 4.10E-03	B B 1			Gd 153	= 2.05E-20	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	= 1.01E-13	B B 2		
Cl 36	= 3.74E-04	B B 1			Lu 174	= 2.65E-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	= 6.72E-16	B B 2			Pb 205				
Fe 55	= 2.16E-07	B B 2			Pb 210	= 6.47E-10	B B 2		
Co 60	= 1.14E-04	B B 2			Bi 208				
Ni 59	= 1.30E-04	B B 2			Bi 210m	= 2.93E-25	B B 2		
Ni 63	= 4.58E-03	B B 2			Po 210	= 6.34E-10	B B 2		
Zn 65	= 6.93E-23	B B 2			Ra 223	= 4.41E-10	B B 2		
Se 79	= 1.86E-04	B B 2			Ra 225	= 1.67E-11	B B 2		
Kr 81					Ra 226	= 1.39E-09	B B 2		
Kr 85					Ra 228	= 3.45E-13	B B 2		
Rb 87	= 7.87E-10	B B 2			Ac 227	= 4.58E-10	B B 2		
Sr 90	= 8.70E+00	B B			Th 227	= 4.41E-10	B B 2		
Zr 93	= 1.40E-03	B B 2			Th 228	= 3.17E-10	B B 2		
Nb 91	= 2.54E-18	B B 2			Th 229	= 1.68E-11	B B 2		
Nb 92	= 1.54E-18	B B 2			Th 230	= 7.93E-08	B B 2		
Nb 93m	= 5.17E-03	B B 2			Th 232	= 3.46E-13	B B 2		
Nb 94	= 7.80E-04	B B 2			Th 234	= 2.52E-07	B B 2		
Mo 93	= 6.42E-03	B B 2			Pa 231	= 5.06E-09	B B 2		
Tc 97	= 4.44E-17	B B 2			Pa 233	= 2.48E-05	B B 2		
Tc 99	= 8.95E-03	B B 2			U 232	= 2.88E-10	B B 2		
Ru 106	= 2.63E-09	B B 2			U 233	= 6.57E-09	B B 2		
Pd 107	= 5.58E-06	B B 2			U 234	= 4.18E-05	B B 2		
Ag 108m	= 1.27E-11	B B 2			U 235	= 8.44E-07	B B 1		
Ag 110m	= 4.09E-18	B B 2			U 236	= 2.37E-06	B B 1		
Cd 109	< 1.68E-07	A 3			U 238	= 2.52E-07	B B 1		
Cd 113m	= 1.11E-04	B B 2			Np 237	= 2.48E-05	B B 2		
Sn 119m	= 5.65E-18	B B 2			Pu 236	= 3.48E-11	B B 2		
Sn 121m	= 1.34E-03	B B 2			Pu 238	= 1.72E-02	B B 1		
Sn 123	= 5.54E-34	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	= 1.88E-05	B B 2			Pu 241	= 1.38E-02	B B 1		
Sb 126	= 4.34E-05	B B 2			Pu 242	= 9.14E-07	B B 1		
Te 125m	= 4.46E-06	B B 2			Am 241	= 2.10E-02	B B 1		
Te 127m	= 8.14E-39	B B 2			Am 242m	= 7.37E-06	B B 2		
I 129	= 9.48E-07	B B 2			Am 243	= 8.92E-06	B B 2		
Cs 134	= 6.99E-06	B B 2			Cm 242	= 6.15E-06	B B 2		
Cs 135	= 1.79E-04	B B 2			Cm 243	= 1.09E-06	B B 2		
Cs 137	= 9.40E+00	B B 2			Cm 244	= 8.74E-05	B B 2		
Ba 133	= 1.60E-13	B B 2			Cm 245	= 1.76E-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	= 1.00E-12	B B 2			Cf 249	= 1.54E-17	B B 2		
Pm 145	= 3.38E-16	B B 2			Cf 250	= 1.12E-17	B B 2		
Pm 147	= 5.29E-04	B B 2			Cf 251	= 1.99E-19	B B 2		
Sm 147	= 2.96E-10	B B 2			Cf 252	= 1.49E-21	B B 2		
Sm 151	= 6.90E-02	B B 2			Unsp a				
Eu 152	= 3.79E-03	B B 2			Unsp b/g				
Eu 154	= 7.79E-03	B B 2			Total a	4.17E-02	*	0	*
Eu 155	= 5.58E-04	B B 2			Total b/g	1.82E+01	*	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 the 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
* Total calculated from the 114 declared radionuclides