WASTE STREAM 5B19 Uranium Contaminated Materials

SITE	Dounreay
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Dounreay Site Restoration Limited
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	Yes

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	63.4 m^3
Total future arisings:		0 m^3
Total waste volume:		63.4 m^3

Comment on volumes: No future arisings. Any further arisings of uranium contaminated material will be covered by decommissioning streams. The natural and depleted uranium metal may not be consigned as part of this waste stream.

Uncertainty factors on volumes:

Stock (upper):	x 1.02	Arisings (upper)	x
Stock (lower):	x 0.98	Arisings (lower)	x

WASTE SOURCE Stored wastes are mainly concrete from floor of building, from refurbishment exercise and additional materials such as uranium slag materials from uranium processing. There are also two drums containing natural uranium and six drums containing depleted uranium metal.

PHYSICAL CHARACTERISTICS

General description: Concrete, sand and plant residues. Smaller amounts of graphite, tools, metal, swabs and plastic bags. In addition there is natural uranium in metal form. Uranium bearing slags originate from the 'billet reduction' stage of operations carried out in the MTR fuel fabrication plant. The slags consist of Calcium Fluoride / Magnesium Fluoride with a small % of Uranium carried over. All items have diameters of less than 16.5cm which is the inner diameter of containers.

Physical components (%vol): Plant residues (57.5%), concrete (25.4%), sand (10.6%), swabs (1.0%), uranium metal (4.6%), others including plastic (<0.9%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): 0.3

Comment on density: The density is based on consignor's records, and includes the sacrificial containers in which the waste is packed.

CHEMICAL COMPOSITION

General description and components (%wt): Ferrous metals(37%), uranium (5%), paper (21%), wood (1%), halogenated plastics (14%), non-halogenated plastics (1%), soil (2%), concrete (5%), residues (14%).

Chemical state: Neutral

Chemical form of radionuclides: Ra: Present in trace amounts.
U: Uranium is present mainly as metal. A small quantity may also be present as dioxide and fluoride.
Np: Present in trace amounts.

Metals and alloys (%wt): Small amount of material may be present as bulk metal associated with the depleted uranium.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	P		
Other ferrous metals.....	37.0		
Iron.....			
Aluminium.....			
Beryllium.....	0		

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Cobalt	0	
Copper		
Lead	0	
Magnox/Magnesium	0	
Nickel		
Titanium		
Uranium	5.0	
Zinc	0.10	
Zircaloy/Zirconium	0	
Other metals	13.9	Metal largely associated with the small amounts of alloys. Molybdenum will be present in small quantities (0.001%). Includes allowance for plant residues.

Organics (%wt): The waste contains paper swabs from repacking. Polythene arises from old bags. The containers used for repacking are PVC. No significant quantities of other organic materials are thought to be present. PVC containers were used for repacking.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	22.0		
Paper, cotton	21.0		
Wood	1.0		
Halogenated plastics	14.0		
Total non-halogenated plastics	1.0		
Condensation polymers	TR		
Others	1.0		
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		

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	0		
Inorganic sludges and flocs	0		
Soil	2.0		
Brick/Stone/Rubble	0		
Cementitious material	5.0		

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Sand	
Glass/Ceramics	
Graphite	P
Desiccants/Catalysts	
Asbestos	0
Non/low friable	
Moderately friable	
Highly friable	
Free aqueous liquids	0
Free non-aqueous liquids	0
Powder/Ash	0

Inorganic anions (%wt): CaF2 MgF slags with a small % of U carried over. Nitrate is present in the waste. Other anions are unlikely to be present.

	(%wt)	Type(s) and comment
Fluoride	~8.0	
Chloride	NE	
Iodide	NE	
Cyanide	NE	
Carbonate	NE	
Nitrate	P	
Nitrite	NE	
Phosphate	NE	
Sulphate	NE	
Sulphide	NE	

Materials of interest for waste acceptance criteria: The waste is unlikely to contain any hazardous materials apart from trace quantities of nitric acid. No significant quantity of free liquids will be present.

	(%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	0	
Corrosive materials		
Pyrophoric materials	0	
Generating toxic gases	0	
Reacting with water	0	
Higher activity particles	NE	

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Soluble solids as bulk chemical compounds..... 0

Hazardous substances / non hazardous pollutants: Small quantities of heavy metals are present.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....		
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): No

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

Total complexing agents..... 0

Potential for the waste to contain discrete items: No.

PACKAGING AND CONDITIONING

Conditioning method: The waste will continue to be stored in 200 litre drums until a conditioning route is available. The current strategy is for this material to be compacted, with the resultant pucks grouted into 500 litre drums. Some waste drums may not be suitable for compaction and these will be directly loaded into 500 l drums. This waste stream will be copackaged into 500L drums alongside all wastes from 5B24 and the CHILW from decommissioning waste streams.

Plant Name: CHILW Repacking Facility

Location: Dounreay

Plant startup date: 2026

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: 2026

Throughput for this stream (m³/y incoming waste): -

Other information: Material may be processed with other CHILW.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
500 l drum	100.0	1	0.5	64

Likely container type comment: The conditioning factor for CHILW is about 0.5

Range in container waste volume: It is estimated that between 2 and 8 CHILW pucks will be placed into each 500l drum with the average being 5 drums per 500l drum. A small percentage of drums may not be suitable for supercompaction and will be directly immobilised into the 500l drum.

Other information on containers: Stainless Steel. Likely to be 316 stainless steel.

Likely conditioning matrix: Cement

Other information: -

Conditioned density (t/m³): ~2.5

Conditioned density comment: The density of the conditioned waste is expected to be around 2 - 3 te/m³.

Other information on conditioning: -

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

RADIOACTIVITY

Source: Uranium fuel contamination.

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Uncertainty:	Within a factor of three.
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 activities in the stocks are based on consignor's records which are based on non-destructive assay.
Other information:	Repacked waste was assayed for U-235 and calculations based on these measurements. Natural uranium waste was not assayed. Decayed from 2019 submission.

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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					Gd 153				
Be 10					Ho 163				
C 14					Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210	2.24E-10	B B 2		
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	2.07E-10	B B 2		
Zn 65					Ra 223	1.02E-08	B B 2		
Se 79					Ra 225				
Kr 81					Ra 226	1.30E-09	B B 2		
Kr 85					Ra 228	8.45E-14	B B 2		
Rb 87					Ac 227	1.03E-08	B B 2		
Sr 90					Th 227	1.01E-08	B B 2		
Zr 93					Th 228	6.72E-14	B B 2		
Nb 91					Th 229				
Nb 92					Th 230	3.60E-07	B B 2		
Nb 93m					Th 232	1.41E-13	B B 2		
Nb 94					Th 234	9.66E-06	B B 2		
Mo 93					Pa 231	3.30E-08	B B 2		
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234	2.55E-03	B B 2		
Ag 108m					U 235	7.81E-05	B B 2		
Ag 110m					U 236	1.64E-04	B B 2		
Cd 109					U 238	9.66E-06	B B 2		
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137					Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					**Total a**	**2.80E-03**	**B B 2**	**0**	
Eu 155					**Total b/g**	**9.67E-06**	**B 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