

WASTE STREAM	5B326	MTR Reprocessing Plant ILW
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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.....	2.2 m ³
Future arisings -	1.4.2022 - 31.3.2023.....	7.5 m ³
	1.4.2023 - 31.3.2024.....	7.5 m ³
	1.4.2024 - 31.3.2025.....	7.5 m ³
	1.4.2025 - 31.3.2026.....	7.5 m ³
	1.4.2026 - 31.3.2027.....	7.5 m ³
	1.4.2027 - 31.3.2028.....	7.5 m ³
	1.4.2028 - 31.3.2029.....	7.5 m ³
	1.4.2029 - 31.3.2030.....	7.5 m ³
	1.4.2030 - 31.3.2031.....	5.0 m ³
	1.4.2031 - 31.3.2032.....	1.7 m ³
	1.4.2032 - 31.3.2033.....	1.7 m ³
	1.4.2033 - 31.3.2034.....	1.7 m ³
	1.4.2034 - 31.3.2035.....	0.4 m ³
Total future arisings:		70.5 m ³
Total waste volume:		72.7 m ³

Comment on volumes: It should be noted that the DSRLs using a provisional LifeTime Plan (LTP) and that arisings dates are subject to change. There has been a change in the pond sludge treatment strategy which has reduced the ILW waste volumes.

Uncertainty factors on volumes: Stock (upper): x 1.02 Arisings (upper) x 1.2
 Stock (lower): x 0.98 Arisings (lower) x 0.8

WASTE SOURCE Contaminated fuel reprocessing plant hardware, concrete shielding. Pond sludge

PHYSICAL CHARACTERISTICS

General description: Fuel reprocessing plant hardware, e.g. vessels, pond equipment and pipework and concrete shielding. Steel vessels will be cut to an economic size and concrete shielding will be size reduced.

Physical components (%vol): Cell Contents (inc Vessels& pipework) (~45%), pond equipment (~45%), concrete (~10%). Small volume of treated sludge (< 1%).

Sealed sources: Not yet determined.

Bulk density (t/m³): 0.72

Comment on density: The density figure is based on consignor's records.

CHEMICAL COMPOSITION

General description and components (%wt): Aluminium (0.15%), Brick/Rubble (22.48%), Cadmium (0.02%), Cementitious material (e.g. concrete) (5.11%), Copper (0.03%), Inorganic sludges and flocs (0.16%), Lead (1.04%), Mild Steel (36.93%), Plastic (0.04%), Stainless steel (32.54%), Titanium (0.89%), WEEE not containing hazardous components (0.05%), Wood/ Wood composite (0.55%),

Chemical state: Neutral

Chemical form of radionuclides: -

Metals and alloys (%wt): The items will be of variable shape and thickness, from disused vessels and pipework.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	32.5	Stainless steel assumed to be 316.	
Other ferrous metals.....	36.9	Mild steel	
Iron.....			
Aluminium.....	0.15		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	0.03		
Lead.....	1.0		
Magnox/Magnesium.....	*0		
Nickel.....			
Titanium.....	0.89		
Uranium.....	0		
Zinc.....	*0		
Zircaloy/Zirconium.....	*0		
Other metals.....	0.08	Cadmium + WEEE + adjust	

Organics (%wt): Trace quantities of organics may be present, and may include cellulose, halogenated plastic, non-halogenated plastic and rubber. PVC and neoprene may be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	0.55		
Paper, cotton.....	TR		
Wood.....	0.55		
Halogenated plastics	TR		
Total non-halogenated plastics.....	0.04		
Condensation polymers.....	NE		
Others.....	0.04		
Organic ion exchange materials....	TR		
Total rubber.....	TR		
Halogenated rubber	TR		
Non-halogenated rubber.....	TR		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	NE		

Other materials (%wt): ILW sludge is present in this wastestream but quantity is unknown. This has been captured with 'evaporation wastes'

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	(%wt)	Type(s) and comment		% of total C14 activity
Inorganic ion exchange materials..	0			
Inorganic sludges and flocs.....	0.16	Reduction due to new evaporation technique		
Soil.....	0			
Brick/Stone/Rubble.....	22.5			
Cementitious material.....	5.1			
Sand.....				
Glass/Ceramics.....				
Graphite.....	0			
Desiccants/Catalysts.....				
Asbestos.....	TR			
Non/low friable.....				
Moderately friable.....				
Highly friable.....				
Free aqueous liquids.....	0			
Free non-aqueous liquids.....	0			
Powder/Ash.....	0			

Inorganic anions (%wt): Inorganic anions may be present.

	(%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: -

	(%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	

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	NE
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / non hazardous pollutants: Lead may be present in trace quantities.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....	NE	
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....	NE	
Styrene.....		
Tri-butyl phosphate.....	NE	
Other organophosphates.....		
Vinyl chloride.....	NE	
Arsenic.....	NE	
Barium.....		
Boron.....	NE	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	0.02	components from misc items in HAC
Caesium.....		
Selenium.....	NE	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....		
Tin.....	NE	
Vanadium.....	NE	
Mercury compounds.....		
Others.....	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		
EEE Type 2.....	1.6	HIAB lifting arm controls (in pond containment), Pond Bridge (Full item, not just WEEE component)
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		

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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: Yes. Hand tools, Durable engineered steel structures, concrete blocks, uncompact putty drums

PACKAGING AND CONDITIONING

Conditioning method: RHILW will be packaged into 500l drums for long term storage. CHILW will be supercompacted with the pucks being encapsulated into 500L drums.

Plant Name: RHILW and CHILW Repackaging Facilities

Location: Dounreay

Plant startup date: 2026 & 2028

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: 2026

Throughput for this stream (m³/y incoming waste): ~8.0

Other information: CHILW and RHILW Repacking plant are in design phase. Assume unconstrained.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l drum	100.0	~0.242	0.5	301

Likely container type comment: The conditioning factor for RHILW will be about 1.7 while that 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. Assume 3:2 Z6033 to 500L drum ratio.

Other information on containers: -

Likely conditioning matrix: Cement

Other information: -

Conditioned density (t/m³): ~2.5

Conditioned density comment: The density is likely to be around 2-3 te/m³

Other information on conditioning: -

Opportunities for alternative disposal routing: No

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Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
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RADIOACTIVITY**Source:**

The facility is a research materials test reactor fuel reprocessing plant. The source of radioactivity from MTR fuel reprocessing work previously carried out in the facility (and also from other research reactors).

Uncertainty:

The estimates given for arisings are based off consignors data. The data for stocks are a proportion of the activity taken from the RHILW Solid and CHILW drummed LoC. RHILW Solid and CHILW drummed LoCs provide a generic activity for all CHILW / RHILW wastes in store.

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:

From LoC data and consignment data.

Other information:

Specific Activities used are from 2019 UKRWI decayed to 2022. Arisings listed in datasheet as LLW. However, this is due to the CHILW content being based on a limited dataset. This dataset involves previously consigned CHILW drums which have been deemed ILW due to a high U235 content rather than activity. This has diluted the overall specific activity when combined with the RHILW component.

WASTE STREAM 5B326 MTR Reprocessing Plant ILW

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3		CC 2			Gd 153				
Be 10	1.10E-07	CC 2			Ho 163				
C 14	2.05E-03	CC 2			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	2.87E-06	CC 2			Pt 193				
Mn 53	1.75E-03	CC 2			Tl 204				
Mn 54	1.51E-08	CC 2			Pb 205				
Fe 55	3.81E-02	CC 2			Pb 210	2.02E-11	CC 2	1.34E-15	CC 2
Co 60	2.39E+00	CC 2			Bi 208				
Ni 59	6.82E-03	CC 2			Bi 210m				
Ni 63	1.84E+00	CC 2			Po 210	1.87E-11	CC 2	8.07E-16	CC 2
Zn 65	2.95E-13	CC 2			Ra 223	9.28E-10	CC 2	7.64E-13	CC 2
Se 79	3.69E-06	CC 2			Ra 225	6.18E-10	CC 2	4.28E-20	CC 2
Kr 81					Ra 226	1.13E-10	CC 2	4.45E-14	CC 2
Kr 85					Ra 228	7.87E-10	CC 2	2.02E-18	CC 2
Rb 87					Ac 227	9.37E-10	CC 2	8.26E-13	CC 2
Sr 90	2.35E-01	CC 2	3.80E-03	CC 2	Th 227	9.19E-10	CC 2	7.76E-13	CC 2
Zr 93	3.37E-05	CC 2			Th 228	1.43E-07	CC 2	5.83E-19	CC 2
Nb 91					Th 229	6.20E-10	CC 2	4.55E-20	CC 2
Nb 92					Th 230	2.87E-08	CC 2	6.84E-11	CC 2
Nb 93m	8.73E-03	CC 2			Th 232	9.65E-10	CC 2	1.25E-17	CC 2
Nb 94	6.34E-04	CC 2			Th 234	5.66E-06	CC 2		
Mo 93	3.79E-03	CC 2			Pa 231	3.30E-09	CC 2	1.79E-11	CC 2
Tc 97					Pa 233	1.34E-06	CC 2	7.92E-11	CC 2
Tc 99	1.82E-04	CC 2			U 232	1.38E-07	CC 2		
Ru 106	1.74E-06	CC 2			U 233	3.65E-07	CC 2	4.98E-16	CC 2
Pd 107					U 234	1.83E-04	CC 2	2.48E-06	CC 2
Ag 108m	2.95E-05	CC 2			U 235	8.07E-06	CC 2	2.82E-07	CC 2
Ag 110m	1.01E-12	CC 2			U 236	9.32E-06	CC 2	8.47E-08	CC 2
Cd 109			3.62E-05	CC 2	U 238	5.66E-06	CC 2		
Cd 113m	3.04E-04	CC 2			Np 237	1.34E-06	CC 2	8.22E-11	CC 2
Sn 119m					Pu 236				
Sn 121m					Pu 238	2.87E-02	CC 2	1.82E-04	CC 2
Sn 123					Pu 239	9.71E-02	CC 2	5.13E-06	CC 2
Sn 126	6.63E-06	CC 2			Pu 240	9.75E-02	CC 2	5.29E-06	CC 2
Sb 125	3.25E-04	CC 2			Pu 241	1.72E+00	CC 2	3.12E-04	CC 2
Sb 126	9.29E-07	CC 2			Pu 242	8.54E-05	CC 2		
Te 125m	8.15E-05	CC 2			Am 241	1.56E-01	CC 2	8.51E-05	CC 2
Te 127m					Am 242m	1.18E-02	CC 2		
I 129	3.11E-07	CC 2			Am 243	1.14E-04	CC 2		
Cs 134	1.75E-04	CC 2			Cm 242	9.77E-03	CC 2		
Cs 135	5.81E-06	CC 2			Cm 243	6.18E-04	CC 2		
Cs 137	6.80E-01	CC 2	6.97E-03	CC 2	Cm 244	5.07E-02	CC 2	6.41E-06	CC 2
Ba 133					Cm 245	1.59E-06	CC 2		
La 137					Cm 246	1.59E-07	CC 2		
La 138					Cm 248				
Ce 144	1.00E-09	CC 2			Cf 249				
Pm 145					Cf 250				
Pm 147	2.52E-03	CC 2			Cf 251				
Sm 147	3.25E-12	CC 2			Cf 252				
Sm 151	2.52E-02	CC 2	1.24E-05	CC 2	Other a			2.42E-12	CC 2
Eu 152	1.9E-02	CC 2			Other b/g	8.50E-07	CC 2	1.04E-02	CC 2
Eu 154	9.46E-03	CC 2	9.66E-05	CC 2	Total a	4.41E-01	CC 2	2.86E-04	CC 2
Eu 155	4.89E-03	CC 2	8.46E-06	CC 2	Total b/g	7.02E+00	CC 2	2.16E-02	CC 2

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