

WASTE STREAM	5B308	PFR 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.....	26.6 m ³
Future arisings -	1.4.2022 - 31.3.2023.....	0.8 m ³
	1.4.2023 - 31.3.2024.....	5.9 m ³
	1.4.2024 - 31.3.2025.....	6.7 m ³
	1.4.2025 - 31.3.2026.....	5.1 m ³
	1.4.2026 - 31.3.2027.....	2.1 m ³
	1.4.2027 - 31.3.2028.....	1.7 m ³
	1.4.2028 - 31.3.2029.....	2.3 m ³
	1.4.2029 - 31.3.2030.....	2.3 m ³
	1.4.2030 - 31.3.2031.....	2.3 m ³
	1.4.2031 - 31.3.2032.....	12.7 m ³
	1.4.2032 - 31.3.2033.....	1.5 m ³
	1.4.2033 - 31.3.2034.....	1.5 m ³
	1.4.2034 - 31.3.2035.....	1.5 m ³
	1.4.2035 - 31.3.2036.....	1.5 m ³
	1.4.2036 - 31.3.2037.....	1.5 m ³
	1.4.2037 - 31.3.2038.....	11.6 m ³
	1.4.2038 - 31.3.2039.....	13.6 m ³
1.4.2039 - 31.3.2040.....	13.6 m ³	
1.4.2040 - 31.3.2041.....	13.6 m ³	
1.4.2041 - 31.3.2042.....	3.6 m ³	
Total future arisings:		105.4 m ³
Total waste volume:		132.0 m ³

Comment on volumes: It should be noted that the DSRL programme is based on a provisional programme and arisings dates are subject to change. ILW arisings will vary through the different stages of decommissioning, dependent on the equipment/structures being removed. The arisings have been revised in line with the output from the plant waste inventory walk round exercise. The stocks consist of CHILW and RHILW from decommissioning projects. Stocks consists of 65 CHILW Drums plus 68 RHILW Z6033 Drums

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 The waste arises from general fuel reprocessing plant decommissioning. It will be both Contact Handleable and Remote Handleable.

PHYSICAL CHARACTERISTICS

General description: The waste consists of in cell/cave processing equipment, debris etc. equipment (assemblies or dismantled), debris items and decommissioning process arisings.

Physical components (%vol): Cementitious material (e.g. concrete) (6.39%), Fibreglass (0.14%), Glass (1.58%), Lead (0.07%), Mild Steel (12.73%), Other (0.06%), Plastic (5.66%), Rubber (0.20%), Stainless steel (72.97%), Sweepings (0.09%), Paper / Cardboard (0.10%),

Sealed sources: Not yet determined.

Bulk density (t/m³): 0.33

Comment on density: Based on consignor's records.

CHEMICAL COMPOSITION

General description and components (%wt): Cementitious material (e.g. concrete) (2.12%), Fibreglass (0.05%), Glass (0.55%), Inorganic sludges and flocs (0.39%), Lead (0.10%), Mild Steel (14.85%), Plastic (0.76%),

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Rubber (0.04%), Stainless steel (81.11%),
 Chemical state: Neutral
 Chemical form of radionuclides: Cl-36: Likely to be present
 I-129: Likely to be present
 Ra: Likely to be present as contamination.
 Th: Likely to be present as contamination.
 U: Likely to be present as contamination.
 Np: Likely to be present as contamination.
 Pu: Likely to be present as contamination.

Metals and alloys (%wt): Both sheet and bulk metals likely to be present, proportions not specified.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	81.1	Any stainless steel is likely to be M316.	
Other ferrous metals.....	14.9		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	TR		
Lead.....	0.10		
Magnox/Magnesium.....	0		
Nickel.....			
Titanium.....			
Uranium.....	TR		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	0.03		

Organics (%wt): PVC and neoprene are present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics	0.35		
Total non-halogenated plastics.....	0.41		
Condensation polymers.....	NE		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0.04		
Halogenated rubber	0.02		
Non-halogenated rubber.....	0.02		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			

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Bitumen.....
 Others.....
 Other organics..... TR

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0.39		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	2.1		
Sand.....	0		
Glass/Ceramics.....	0.60		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	NE		

Inorganic anions (%wt): Trace quantities may be present dependent on operations being undertaken.

	(%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	

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

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

	(%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.....	NE	
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.....		
EEE Type 3.....		

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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: Yes. stainless steel tanks etc approx. 70m3

PACKAGING AND CONDITIONING

Conditioning method: Remote Handled ILW will be packaged into 500 litre drums for long term storage. Contact Handled ILW will be supercompacted with the pucks being encapsulated in 500 litre drums for long term storage.

Plant Name: CHILW Repackaging Facility and RHILW Repackaging Facility

Location: Dounreay

Plant startup date: 2026 and 2028 respectively

Total capacity (m³/y incoming waste): 13.6

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): 5.3

Other information: Plants are currently in design phase

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
	500 l drum	100.0	0.284	0.5	465

Likely container type comment: The conditioning factor for RHILW is 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 500 ltr 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 500 ltr drum.

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 t/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
-	-	-	-	-	-

RADIOACTIVITY

Source: The main sources of activity are activated and contaminated equipment/structures.

Uncertainty: Stocks data is taken from RHILW Soil and CHILW drummed LoCs. These 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: Stocks is based on LoC data for ILW in stocks. Arisings is based on consignors data.

Other information: Specific activity uses UKRWI 2019 data decayed to 2022

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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	6.30E-03	CC 2			Gd 153				
Be 10	3.09E-08	CC 2			Ho 163				
C 14	5.78E-04	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	8.09E-07	CC 2			Pt 193				
Mn 53	4.94E-04	CC 2			Tl 204				
Mn 54	1.21E-03	CC 2	3.72E-04	CC 2	Pb 205				
Fe 55	1.07E-02	CC 2			Pb 210	4.62E-12	CC 2	1.14E-16	CC 2
Co 60	7.00E-01	CC 2	2.86E-02	CC 2	Bi 208				
Ni 59	1.92E-03	CC 2			Bi 210m				
Ni 63	5.20E-01	CC 2			Po 210	4.28E-12	CC 2	6.08E-17	CC 2
Zn 65	8.32E-14	CC 2			Ra 223	2.13E-10	CC 2	2.58E-16	CC 2
Se 79	1.04E-06	CC 2			Ra 225	1.74E-10	CC 2	5.42E-17	CC 2
Kr 81					Ra 226	2.58E-11	CC 2	5.03E-15	CC 2
Kr 85					Ra 228	1.80E-10	CC 2	1.45E-19	CC 2
Rb 87					Ac 227	2.15E-10	CC 2	2.91E-16	CC 2
Sr 90	4.33E-01	CC 2	4.65E-01	CC 2	Th 227	2.11E-10	CC 2	2.66E-16	CC 2
Zr 93	9.48E-06	CC 2			Th 228	3.28E-08	CC 2	3.45E-20	CC 2
Nb 91					Th 229	1.75E-10	CC 2	5.76E-17	CC 2
Nb 92					Th 230	6.57E-09	CC 2	1.16E-11	CC 2
Nb 93m	2.46E-03	CC 2			Th 232	2.21E-10	CC 2	1.30E-18	CC 2
Nb 94	1.79E-04	CC 2			Th 234	1.40E-06	CC 2	5.12E-18	CC 2
Mo 93	1.07E-03	CC 2			Pa 231	7.56E-10	CC 2	9.35E-15	CC 2
Tc 97					Pa 233	4.01E-07	CC 2	1.06E-07	CC 2
Tc 99	5.12E-05	CC 2			U 232	3.16E-08	CC 2		
Ru 106	2.73E-03	CC 2	1.11E-03	CC 2	U 233	1.03E-07	CC 2	6.43E-13	CC 2
Pd 107					U 234	4.24E-05	CC 2	8.37E-07	CC 2
Ag 108m	8.32E-06	CC 2			U 235	1.85E-06	CC 2	2.96E-10	CC 2
Ag 110m	2.83E-13	CC 2			U 236	2.14E-06	CC 2	1.75E-08	CC 2
Cd 109					U 238	1.40E-06	CC 2	5.46E-18	CC 2
Cd 113m	8.58E-05	CC 2			Np 237	4.05E-07	CC 2	1.10E-07	CC 2
Sn 119m					Pu 236				
Sn 121m					Pu 238	8.27E-02	CC 2	9.77E-02	CC 2
Sn 123					Pu 239	1.03E-01	CC 2	1.00E-01	CC 2
Sn 126	1.87E-06	CC 2			Pu 240	1.79E-01	CC 2	2.00E-01	CC 2
Sb 125	9.16E-03	CC 2	8.00E-03	CC 2	Pu 241	4.72E+00	CC 2	5.19E+00	CC 2
Sb 126	2.62E-07	CC 2			Pu 242	2.31E-05	CC 2	3.93E-09	CC 2
Te 125m	2.05E-03	CC 2	1.89E-03	CC 2	Am 241	1.28E-01	CC 2	1.26E-01	CC 2
Te 127m					Am 242m	6.54E-03	CC 2	4.18E-03	CC 2
I 129	8.75E-08	CC 2			Am 243	3.21E-05	CC 2	6.78E-10	CC 2
Cs 134	1.84E-02	CC 2	1.40E-02	CC 2	Cm 242	4.83E-03	CC 2	3.45E-03	CC 2
Cs 135	1.64E-06	CC 2			Cm 243	9.41E-04	CC 2	9.70E-04	CC 2
Cs 137	9.26E-01	CC 2	9.33E-01	CC 2	Cm 244	2.28E-02	CC 2	1.06E-02	CC 2
Ba 133					Cm 245	4.48E-07	CC 2		
La 137					Cm 246	4.47E-08	CC 2		
La 138					Cm 248	7.66E-02	CC 2	1.01E-01	CC 2
Ce 144	2.83E-10	CC 2			Cf 249				
Pm 145					Cf 250				
Pm 147	1.06E-01	CC 2	9.05E-02	CC 2	Cf 251				
Sm 147	2.08E-12	CC 2	2.71E-12	CC 2	Cf 252	1.58E+02	CC 2	1.37E+02	CC 2
Sm 151	5.18E-02	CC 2	5.80E-02	CC 2	Other a			2.62E-09	CC 2
Eu 152	5.35E-03	CC 2			Other b/g	8.13E-07	CC 2	1.35E+00	CC 2
Eu 154	1.41E-02	CC 2	1.33E-02	CC 2	Total a	1.59E+02	CC 2	1.37E+02	CC 2
Eu 155	2.50E-02	CC 2	2.47E-02	CC 2	Total b/g	7.56E+00	CC 2	8.18E+00	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