

WASTE STREAM	5B317	Pu Laboratory 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.....	18.2 m ³
Total future arisings:		0 m ³
Total waste volume:		18.2 m ³
Comment on volumes:	Building demolished, no further arisings. The volume quoted is 'as stored' in 90x200 litre drums.	
Uncertainty factors on volumes:	Stock (upper): x 1.02	Arisings (upper) x
	Stock (lower): x 0.98	Arisings (lower) x

WASTE SOURCE Decommissioning of plutonium laboratory building.

PHYSICAL CHARACTERISTICS

General description: -
 Physical components (%wt): Mainly metal items (50%) such as gloveboxes, various plastics (10%), cellulosic materials (30% and small amounts of building materials (5%) and other unspecified materials (5%).
 Sealed sources: -
 Bulk density (t/m³): 0.53
 Comment on density: The density of 0.53 te/m³ is based on consignor's drum records.

CHEMICAL COMPOSITION

General description and components (%wt): Metal (50%), soil/concrete/rubble (5%), soft organics (5%), plastics/rubber (10%), wood (5%), sponge media (20%), others (5%).
 Chemical state: Neutral
 Chemical form of radionuclides: Cl-36: Not likely to be present
 I-129: Not likely to be present
 Ra: Radium isotopes may be present in a smoke detector.
 Pu: Wastes generated by this waste stream are generally contaminated with plutonium bearing residues principally PuNO₃.
 Metals and alloys (%wt): Both sheet and bulk metals are present, proportions not specified.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	50.0		
Other ferrous metals.....	TR		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	TR		
Lead.....	TR		
Magnox/Magnesium.....	0		
Nickel.....	0		
Titanium.....			

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Uranium.....	P
Zinc.....	0
Zircaloy/Zirconium.....	0
Other metals.....	5.0

Organics (%wt): The waste contains small amounts of halogenated plastic, non-halogenated plastic and rubber.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	30.0		
Paper, cotton.....	25.0		
Wood.....	5.0		
Halogenated plastics	10.0		
Total non-halogenated plastics.....	NE		
Condensation polymers.....	NE		
Others.....	NE		
Organic ion exchange materials....	0		
Total rubber.....	NE		
Halogenated rubber	NE		
Non-halogenated rubber.....	NE		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
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		
Soil.....	5.0		
Brick/Stone/Rubble.....	TR		
Cementitious material.....	TR		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		

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Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
Fluoride.....	NE	
Chloride.....	NE	
Iodide.....	NE	
Cyanide.....	0	
Carbonate.....	NE	
Nitrate.....	TR	
Nitrite.....	0	
Phosphate.....	NE	
Sulphate.....	NE	
Sulphide.....	NE	

Materials of interest for waste acceptance criteria: There are no hazardous materials in the waste.

	(%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.....	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: -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....	NE	
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....	NE	

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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.....	
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 5B19, 5B24 and the CHILW from decommissioning waste streams.

Plant Name: CHILW Repacking Facility

Location: Dounreay

Plant startup date: 2026

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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 (m ³)	Payload (m ³)	Number of packages
	500 l drum	100.0	1	0.5	19

Likely container type comment: It is assumed that 5 pucks will be packaged in each 500 litre drum, giving a conditioning factor of 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: 316 Stainless steel.

Likely conditioning matrix: Cement

Other information: -

Conditioned density (t/m³): ~2.5

Conditioned density comment: The conditioned density may lie in the range 2- 3 t/m³ dependent on supercompactor performance.

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: The operations in the facility were originally conducted with grade A plutonium. This forms the only source of the resulting contamination within the facility.

Uncertainty: Within a factor of three for stocks.

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 isotopic composition of this material from the Building Safety Case is 0.1% Pu238, 95.1% Pu239, 4.5% Pu240, 0.1% Pu241, 0.01% Pu242 and 0.3% Am241. Total activities and radionuclide profiles are derived from the WSCD for this waste.

Other information: Radionuclides are from 2019 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					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				
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223	1.48E-14	BB 2		
Se 79					Ra 225	3.17E-15	BB 2		
Kr 81					Ra 226				
Kr 85					Ra 228	4.22E-19	BB 2		
Rb 87					Ac 227	1.49E-14	BB 2		
Sr 90					Th 227	1.46E-14	BB 2		
Zr 93					Th 228	3.87E-19	BB 2		
Nb 91					Th 229	3.17E-15	BB 2		
Nb 92					Th 230				
Nb 93m					Th 232	5.36E-19	BB 2		
Nb 94					Th 234				
Mo 93					Pa 231	3.43E-14	BB 2		
Tc 97					Pa 233	1.18E-08	BB 2		
Tc 99					U 232				
Ru 106					U 233	1.62E-12	BB 2		
Pd 107					U 234				
Ag 108m					U 235	5.14E-11	BB 2		
Ag 110m					U 236	3.45E-10	BB 2		
Cd 109					U 238				
Cd 113m					Np 237	1.19E-08	BB 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239	8.29E-04	BB 2		
Sn 126					Pu 240	1.85E-04	BB 2		
Sb 125					Pu 241	2.59E-03	BB 2		
Sb 126					Pu 242				
Te 125m					Am 241	5.88E-04	BB 2		
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	1.60E-03	BB 2	0	
Eu 155					Total b/g	2.59E-03	BB 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