

WASTE STREAM	5B308	PFR Reprocessing Plant ILW
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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			
Future arisings:	1.4.2027 - 31.3.2028			
	1.4.2028 - 31.3.2029			
	1.4.2029 - 31.3.2030			
	1.4.2030 - 31.3.2031			
	1.4.2031 - 31.3.2032			
	1.4.2032 - 31.3.2033			
	1.4.2033 - 31.3.2034			
	1.4.2034 - 31.3.2035			
	1.4.2035 - 31.3.2036			
	1.4.2036 - 31.3.2037			
	1.4.2037 - 31.3.2038			
	1.4.2038 - 31.3.2039			
	1.4.2039 - 31.3.2040			
	1.4.2040 - 31.3.2041			
	1.4.2041 - 31.3.2042			
	1.4.2042 - 31.3.2043			
	1.4.2043 - 31.3.2044			
	1.4.2044 - 31.3.2045			
	1.4.2045 - 31.3.2046			
	1.4.2046 - 31.3.2047			
	1.4.2047 - 31.3.2048			
	1.4.2048 - 31.3.2049			
	1.4.2049 - 31.3.2050			
	1.4.2050 - 31.3.2051			
	1.4.2051 - 31.3.2052			
	1.4.2052 - 31.3.2053			
	1.4.2053 - 31.3.2054			
	1.4.2054 - 31.3.2055			
	1.4.2055 - 31.3.2056			
	1.4.2056 - 31.3.2057			
	1.4.2057 - 31.3.2058			
	1.4.2058 - 31.3.2059			
Total future arisings:	108.3			
Total waste volume:	139.1			

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

Comment on arising rates: Arisings data are taken from Dounreay's Lifetime Plan 2024 as generated at December 2023.

Additional information on quantities: The stocks consist of CHILW and RHILW from decommissioning projects. Stocks consists of 86 CHILW Drums plus 68 RHILW Z6033 Drums

Uncertainty factors on volumes: Stock (upper): x 1.02 Arisings (upper): x 1.20
Stock (lower): x 0.98 Arisings (lower): x 0.80

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.

Changes since waste generated: -

Bulk density (t/m³): = 0.33

Comment on density: Based on actuals data from Dounreay's waste consignment system. Data considered acceptable for 2025 submission.

CHEMICAL COMPOSITION

General description and components (%wt):

Asbestos (TR), Cementitious material (e.g. concrete) (6.22%), Fibreglass (0.14%), Glass (1.54%), Lead (0.06%), Mild Steel (12.95%), Other (0.06%), Paper (0.12%), Plastic (5.51%), Rubber (0.19%), Sources (TR), Stainless steel (72.60%), Sweepings (0.09%), Titanium (0.51%), Wood/ Wood composite (TR),

Chemical state:

Neutral

Sheet metal proportion / thickness: 0.54% by wt of all metals will be sheet from ventilation and ducting. Assumed sheet metal thickness is of a range between 1.6-2.5mm.

39.68% by wt of all metals will be bulk from tanks and gloveboxes.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 72.6	Any stainless steel is likely to be M316.	
Other ferrous metals.....	= 13.0		
Iron.....	= 0		
Aluminium.....	= 0		
Beryllium.....	= 0		
Cobalt.....	= 0		
Copper.....	TR		
Lead.....	= 0.06		
Magnox/Magnesium.....	= 0		
Nickel.....	= 0		
Titanium.....	= 0.51		
Uranium.....	TR		
Zinc.....	= 0		
Zircaloy/Zirconium.....	= 0		
Other metals.....	< 0.01	sources	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	= 0.12		
Paper, cotton.....	= 0.12		
Wood.....	< 0.01		
Halogenated plastics.....	= 2.8		
Total non-halogenated plastics.....	= 2.8		
Condensation polymers.....	NE		
Others.....	-		
Organic ion exchange materials.....	= 0		
Total rubber.....	= 0.19		
Halogenated rubber.....	-		
Non-halogenated rubber.....	-		
Hydrocarbons.....	NE		
Oil or grease.....	NE		
Fuel.....	NE		
Asphalt/Tarmac (cont.coal tar).....	NE		
Asphalt/Tarmac (no coal tar).....	NE		
Bitumen.....	NE		
Others.....	NE		
Other organics.....	= 0.06		

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.....	= 6.2		
Sand.....	= 0		
Glass/Ceramics.....	= 1.7		
Graphite.....	= 0		
Desiccants/Catalysts.....	0		
Asbestos.....	< 0.01		
Non/low friable.....	NE		
Moderately friable.....	NE		
Highly friable.....	NE		
Free aqueous liquids.....	= 0		
Free non-aqueous liquids.....	= 0		
Powder/Ash.....	NE 0.09		

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

Inorganic anions (%wt):

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

Complexing agents (%wt):

Not yet determined		
	(%wt)	Type(s) and comment
EDTA.....	NE	-
DPTA.....	NE	-
NTA.....	NE	-
Polycarboxylic acids.....	NE	-
Other organic complexants.....	NE	-
Total complexing agents.....	NE 0	-

Physical components:

	Number	Type(s) and comment
Sources.....	= 4	Solid Pu239, Am241
Electronic & Electrical Equipment (EEE)	-	-
EEE Type 1.....	= 0	-
EEE Type 2.....	= 0	-
EEE Type 3.....	= 1	Air dryer
EEE Type 4.....	= 7	Fluorescent tubes
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:

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. For RHILW, It is estimated that the waste contained in 3 x Z6033 Drums will be packaged into 2 x 500 L Drums.

Conditioning method:

"Waste will be conditioned using a grout matrix into 500L drums. This will be done through a dedicated ILW repackaging facility, which will handle both RHILW and CHILW 200L drums. This facility will produce conditioned 500L drums."

Conditioning plants:

Plant Name	Location
Combined ILW Repackaging Facility	Dounreay

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

Dounreay uses: OPC 1:3 PFA 42% water

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 (basket for waste)	57.4	0.21	0.40	380	-
500 l drum (pucks)	42.6	0.59	0.40	102	-

Range in container waste loading:

For CHILW - 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. For RHILW it is estimated that the waste packaged into 3 x Z6033 drums will be packed (on average) into 2 x 500 L Drums

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

~ 2.5

Conditioned density comment:

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

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: Not yet determined

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
Non-NSDF HAW	Dounreay LLWDV	NE	RED	There is potential for LLW to be diverted out of this stream during repackaging of ILW into 500L drums. However, details of this will be confirmed through the design process of the repackaging facility

RADIOACTIVITY

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

Uncertainty: -

Measurement of radioactivities: Stocks and arisings data is based on consignors records

Chemical form of radionuclides:

- H-3: -
- C-14: -
- Cl-36: Likely to be present
- Se-79: -
- Tc-99: -
- 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.

WASTE STREAM 5B308 PFR Reprocessing Plant ILW									
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					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					Ti 204				
Mn 54	= 1.71E-05	C C 2	= 1.71E-05	C C 2	Pb 205				
Fe 55					Pb 210	= 9.38E-16	C C 2	= 9.38E-16	C C 2
Co 60	= 1.01E-02	C C 2	= 1.01E-02	C C 2	Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	= 6.66E-16	C C 2	= 6.66E-16	C C 2
Zn 65					Ra 223	= 1.12E-15	C C 2	= 1.12E-15	C C 2
Se 79					Ra 225	= 2.62E-16	C C 2	= 2.62E-16	C C 2
Kr 81					Ra 226	= 2.09E-14	C C 2	= 2.09E-14	C C 2
Kr 85					Ra 228	= 5.51E-19	C C 2	= 5.51E-19	C C 2
Rb 87					Ac 227	= 1.19E-15	C C 2	= 1.19E-15	C C 2
Sr 90	= 2.27E-01	C C 2	= 2.27E-01	C C 2	Th 227	= 1.13E-15	C C 2	= 1.13E-15	C C 2
Zr 93					Th 228	= 2.11E-19	C C 2	= 2.11E-19	C C 2
Nb 91					Th 229	= 2.70E-16	C C 2	= 2.70E-16	C C 2
Nb 92					Th 230	= 2.40E-11	C C 2	= 2.40E-11	C C 2
Nb 93m					Th 232	= 2.71E-18	C C 2	= 2.71E-18	C C 2
Nb 94					Th 234	= 1.10E-17	C C 2	= 1.10E-17	C C 2
Mo 93					Pa 231	= 1.96E-14	C C 2	= 1.96E-14	C C 2
Tc 97					Pa 233	= 1.25E-07	C C 2	= 1.25E-07	C C 2
Tc 99					U 232	=			
Ru 106	= 7.53E-05	C C 2	= 7.53E-05	C C 2	U 233	= 1.51E-12	C C 2	= 1.51E-12	C C 2
Pd 107					U 234	= 8.65E-07	C C 2	= 8.65E-07	C C 2
Ag 108m					U 235	= 3.09E-10	C C 2	= 3.09E-10	C C 2
Ag 110m					U 236	= 1.83E-08	C C 2	= 1.83E-08	C C 2
Cd 109					U 238	= 1.14E-17	C C 2	= 1.14E-17	C C 2
Cd 113m					Np 237	= 1.28E-07	C C 2	= 1.28E-07	C C 2
Sn 119m					Pu 236				
Sn 121m					Pu 238	= 4.99E-02	C C 2	= 4.99E-02	C C 2
Sn 123					Pu 239	= 5.22E-02	C C 2	= 5.22E-02	C C 2
Sn 126					Pu 240	= 1.04E-01	C C 2	= 1.04E-01	C C 2
Sb 125	= 1.97E-03	C C 2	= 1.97E-03	C C 2	Pu 241	= 2.34E+00	C C 2	= 2.34E+00	C C 2
Sb 126					Pu 242	= 4.08E-09	C C 2	= 4.08E-09	C C 2
Te 125m	= 4.65E-04	C C 2	= 4.65E-04	C C 2	Am 241	= 7.79E-02	C C 2	= 7.79E-02	C C 2
Te 127m					Am 242m	= 2.15E-03	C C 2	= 2.15E-03	C C 2
I 129					Am 243	= 6.89E-10	C C 2	= 6.89E-10	C C 2
Cs 134	= 2.67E-03	C C 2	= 2.67E-03	C C 2	Cm 242	= 1.79E-03	C C 2	= 1.79E-03	C C 2
Cs 135					Cm 243	= 4.76E-04	C C 2	= 4.76E-04	C C 2
Cs 137	= 4.57E-01	C C 2	= 4.57E-01	C C 2	Cm 244	= 4.95E-03	C C 2	= 4.95E-03	C C 2
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248	= 5.31E-02	C C 2	= 5.31E-02	C C 2
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147	= 2.15E-02	C C 2	= 2.15E-02	C C 2	Cf 251				
Sm 147	= 2.06E-12	C C 2	= 2.06E-12	C C 2	Cf 252	= 3.24E+01	C C 2	= 3.24E+01	C C 2
Sm 151	= 2.97E-02	C C 2	= 2.97E-02	C C 2	Unsp a				
Eu 152					Unsp b/g				
Eu 154	= 5.48E-03	C C 2	= 5.48E-03	C C 2	Total a	3.17E+01	*	3.17E+01	*
Eu 155	= 8.34E-03	C C 2	= 8.34E-03	C C 2	Total b/g	4.11E+00	*	4.11E+00	*

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