

WASTE STREAM	5B307	PFR Reprocessing Plant LLW
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SITE Dounreay

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE LLW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025			
Future arisings:	1.4.2025 - 31.3.2026	= 50.2		
	1.4.2026 - 31.3.2027	= 50.2		
	1.4.2027 - 31.3.2028	= 54.5		
	1.4.2028 - 31.3.2029	= 58.7		
	1.4.2029 - 31.3.2030	= 70.0		
	1.4.2030 - 31.3.2031	= 64.9		
	1.4.2031 - 31.3.2032	= 74.5		
	1.4.2032 - 31.3.2033	= 102.1		
	1.4.2033 - 31.3.2034	= 109.2		
	1.4.2034 - 31.3.2035	= 74.1		
	1.4.2035 - 31.3.2036	= 72.8		
	1.4.2036 - 31.3.2037	= 75.6		
	1.4.2037 - 31.3.2038	= 71.7		
	1.4.2038 - 31.3.2039	= 71.0		
	1.4.2039 - 31.3.2040	= 64.6		
	1.4.2040 - 31.3.2041	= 63.3		
	1.4.2041 - 31.3.2042	= 59.3		
	1.4.2042 - 31.3.2043	= 57.5		
	1.4.2043 - 31.3.2044	= 58.4		
	1.4.2044 - 31.3.2045	= 62.8		
	1.4.2045 - 31.3.2046	= 59.4		
	1.4.2046 - 31.3.2047	= 62.8		
	1.4.2047 - 31.3.2048	= 65.0		
	1.4.2048 - 31.3.2049	= 65.5		
	1.4.2049 - 31.3.2050	= 65.3		
	1.4.2050 - 31.3.2051	= 62.4		
	1.4.2051 - 31.3.2052	= 59.4		
	1.4.2052 - 31.3.2053	= 59.5		
	1.4.2053 - 31.3.2054	= 57.2		
	1.4.2054 - 31.3.2055	= 63.4		
	1.4.2055 - 31.3.2056	= 59.0		
	1.4.2056 - 31.3.2057	= 66.5		
	1.4.2057 - 31.3.2058	= 61.9		
	1.4.2058 - 31.3.2059	= 53.1		
	1.4.2059 - 31.3.2060	= 50.2		
	1.4.2060 - 31.3.2061	= 50.3		
	1.4.2061 - 31.3.2062	= 51.7		
	1.4.2062 - 31.3.2063	= 30.2		
Total future arisings:	2408.0			
Total waste volume:	2408.0			

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

Comment on arising rates: It should be noted that site programme data is based on the Dounreay LTP24 as at December 2023 and future arisings dates are subject to change. Arising volumes have been revised in line with the revised programme

Additional information on quantities: -

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

WASTE SOURCE The waste arises from general fast reactor fuel reprocessing plant decommissioning.

PHYSICAL CHARACTERISTICS

General description: The waste consists of contaminated equipment (cell/glovebox/general), tanks, vessels, pipework, swabs, PVC bagging, etc. Large items may be size reduced during decommissioning.

Changes since waste generated: -

Bulk density (t/m³): = 0.37

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):

Aluminium (1.02%), Asbestos (0.11%), Batteries and Accumulators (TR), Brass (0.13%), Cementitious material (e.g. concrete) (2.76%), Ceramics (0.02%), Copper (0.50%), Fabric (TR), Fibreglass (0.33%), Glass (0.16%), Gypsum Plasterboard/ Fibreboard (0.13%), Lead (1.48%), Mild Steel (30.04%), Other (1.87%), Other organics (TR), Paper (12.45%), Plastic (38.00%), Rubber (2.41%), Soil/Stone (TR), Sources (TR), Stainless steel (2.67%), Wood/ Wood composite (5.93%),

Chemical state:

Neutral

Sheet metal proportion / thickness: 3.48% 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.
1.82% 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.....	= 2.7	-	
Other ferrous metals.....	= 30.0	-	
Iron.....	= 0	-	
Aluminium.....	= 1.0	-	
Beryllium.....	= 0	-	
Cobalt.....	= 0	-	
Copper.....	= 0.63	Copper (1.65%wt), Brass (0.40%wt)	
Lead.....	= 1.5	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	= 0	-	
Titanium.....	= 0	-	
Uranium.....	= 0	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	< 0.01	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 18.4	-	
Paper, cotton.....	= 12.4	-	
Wood.....	= 5.9	-	
Halogenated plastics.....	= 19.0	-	
Total non-halogenated plastics.....	= 19.0	-	
Condensation polymers.....	NE	-	
Others.....	NE	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	= 2.4	-	
Halogenated rubber.....	NE	-	
Non-halogenated rubber.....	NE	-	
Hydrocarbons.....	= 0	-	
Oil or grease.....	= 0	-	
Fuel.....	NE	-	
Asphalt/Tarmac (cont.coal tar).....	= 0	-	
Asphalt/Tarmac (no coal tar).....	= 0	-	
Bitumen.....	= 0	-	
Others.....	= 0	-	
Other organics.....	= 1.9	Other organics 0.00%, Other 1.87%,	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 0	-	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	< 0.01	-	
Brick/Stone/Rubble.....	= 0.13	Plasterboard	
Cementitious material.....	= 2.8	-	
Sand.....	0	-	
Glass/Ceramics.....	= 0.51	Ceramics 0.02%, Glass 0.16%, Fibreglass 0.33%,	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	= 0	-	
Asbestos.....	= 0.11	-	
Non/low friable.....	NE	-	
Moderately friable.....	NE	-	
Highly friable.....	NE	-	
Free aqueous liquids.....	= 0	-	
Free non-aqueous liquids.....	= 0	-	
Powder/Ash.....	= 0	-	

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.....	NE	-
Carbonate.....	NE	-
Nitrate.....	P	-
Nitrite.....	NE	-
Phosphate.....	NE	-
Sulphate.....	= 0.13	Gypsum
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.....	NE	-
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	-
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	-

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	-

Physical components:

	Number	Type(s) and comment
Sources.....	3	Solid - 2x Cs137, 1x Sr90
Electronic & Electrical Equipment (EEE)		-
EEE Type 1.....	4	Computers
EEE Type 2.....	5	Air Handling Units; Refrigeration unit
EEE Type 3.....	82	Control panels; vacuums
EEE Type 4.....	49	Fluorescent lights
EEE Type 5.....		-

Planned on-site / off-site treatment(s):

Comments on planned treatments:

Conditioning method:

For LLW, waste will be grouted into non IP rated HHISOs through a dedicated grouting facility

Conditioning plants:

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

Dounreay will use: OPC 1:3 PFA ~35% water content and plasticiser

Likely container type:

Range in container waste loading:

Other information on packaging and conditioning:

Conditioned density (t/m³):

~ 2.0

Conditioned density comment:

Management Routes:

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Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
Dounreay LLWDV	Incineration facility	< 84.0	GREEN	This opportunity is still at an early stage of development. A small scale trial has taken place. This can potentially divert up to all compactable LLW. The incinerables waste route % is a theoretical maximum based on 100% of drummed LLW being suitable for incineration. This % is subject to further review by NRS Dounreay
Dounreay LLWDV	Metal treatment facility	< 16.0	GREEN	Trials have progressed to open the Metal Treatment Route. It is expected that the waste route will open in 2025. The metallic waste treatment route % remains indicative and is subject to further review and characterisation by NRS Dounreay

RADIOACTIVITY

Source: Contamination with actinides and fission products

Uncertainty: Within a factor of 10

Measurement of radioactivities: Derived from consignor's records

Chemical form of radionuclides:

- H-3: Likely to be present.
- C-14: Likely to be present.
- Cl-36: Unlikely to be present
- Se-79: Likely to be present.
- Tc-99: Likely to be present.
- I-129: Likely to be present.
- Ra: Possibly present in very small quantities.
- Th: Likely to be present.
- U: Likely to be present.
- Np: Likely to be present.
- Pu: Likely to be present.

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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			4.27E-13	C C 2	Pb 205				
Fe 55					Pb 210			1.40E-18	C C 2
Co 60			2.76E-08	C C 2	Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210			1.07E-18	C C 2
Zn 65					Ra 223			2.55E-16	C C 2
Se 79					Ra 225			2.39E-21	C C 2
Kr 81					Ra 226			2.36E-17	C C 2
Kr 85					Ra 228			1.17E-21	C C 2
Rb 87					Ac 227			2.65E-16	C C 2
Sr 90			5.74E-07	C C 2	Th 227			2.55E-16	C C 2
Zr 93					Th 228			5.54E-22	C C 2
Nb 91					Th 229			2.47E-21	C C 2
Nb 92					Th 230			1.83E-14	C C 2
Nb 93m					Th 232			4.07E-21	C C 2
Nb 94					Th 234			8.65E-10	C C 2
Mo 93					Pa 231			2.95E-15	C C 2
Tc 97					Pa 233			1.07E-12	C C 2
Tc 99					U 232				
Ru 106			1.88E-12	C C 2	U 233			1.34E-17	C C 2
Pd 107					U 234			3.34E-10	C C 2
Ag 108m					U 235			2.33E-11	C C 2
Ag 110m					U 236			1.38E-11	C C 2
Cd 109					U 238			8.65E-10	C C 2
Cd 113m					Np 237			1.09E-12	C C 2
Sn 119m					Pu 236				
Sn 121m					Pu 238			3.46E-07	C C 2
Sn 123					Pu 239			4.38E-07	C C 2
Sn 126					Pu 240			5.46E-07	C C 2
Sb 125			4.91E-11	C C 2	Pu 241			7.64E-06	C C 2
Sb 126					Pu 242			1.44E-10	C C 2
Te 125m			1.16E-11	C C 2	Am 241			6.00E-07	C C 2
Te 127m					Am 242m			3.05E-09	C C 2
I 129					Am 243			1.93E-16	C C 2
Cs 134			6.36E-09	C C 2	Cm 242			2.55E-09	C C 2
Cs 135					Cm 243			1.33E-10	C C 2
Cs 137			1.58E-06	C C 2	Cm 244			2.04E-08	C C 2
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147			4.96E-08	C C 2	Cf 251				
Sm 147			4.77E-18	C C 2	Cf 252				
Sm 151			7.49E-08	C C 2	Unsp a				
Eu 152					Unsp b/g				
Eu 154			4.43E-08	C C 2	Total a	0	*	1.96E-06	*
Eu 155			3.01E-08	C C 2	Total b/g	0	*	1.00E-05	*

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