

WASTE STREAM	5B315	MTR 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	= 0		
Future arisings:	1.4.2025 - 31.3.2026	= 42.8		
	1.4.2026 - 31.3.2027	= 43.7		
	1.4.2027 - 31.3.2028	= 45.8		
	1.4.2028 - 31.3.2029	= 42.9		
	1.4.2029 - 31.3.2030	= 42.8		
	1.4.2030 - 31.3.2031	= 42.8		
	1.4.2031 - 31.3.2032	= 42.8		
	1.4.2032 - 31.3.2033	= 42.9		
	1.4.2033 - 31.3.2034	= 42.8		
	1.4.2034 - 31.3.2035	= 42.8		
	1.4.2035 - 31.3.2036	= 44.5		
	1.4.2036 - 31.3.2037	= 45.7		
	1.4.2037 - 31.3.2038	= 45.6		
	1.4.2038 - 31.3.2039	= 45.6		
	1.4.2039 - 31.3.2040	= 52.7		
	1.4.2040 - 31.3.2041	= 54.8		
	1.4.2041 - 31.3.2042	= 45.6		
	1.4.2042 - 31.3.2043	= 45.6		
	1.4.2043 - 31.3.2044	= 45.6		
	1.4.2044 - 31.3.2045	= 48.6		
	1.4.2045 - 31.3.2046	= 61.0		
	1.4.2046 - 31.3.2047	= 96.9		
	1.4.2047 - 31.3.2048	= 46.0		
	1.4.2048 - 31.3.2049	= 45.7		
	1.4.2049 - 31.3.2050	= 45.6		
	1.4.2050 - 31.3.2051	= 45.6		
	1.4.2051 - 31.3.2052	= 66.6		
	1.4.2052 - 31.3.2053	= 87.9		
	1.4.2053 - 31.3.2054	= 43.9		
Total future arisings:	1445.4			
Total waste volume:	1445.4			

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

Comment on arising rates: Programme data is based on Life Time Plan 2024 dataset generated in December 2023

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 LLW contaminated fuel reprocessing plant hardware, concrete shielding.

PHYSICAL CHARACTERISTICS

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

Changes since waste generated: -

Bulk density (t/m³): = 0.41

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 (0.77%), Asbestos (0.15%), Asphalt (0.45%), Brick/Rubble (1.39%), Cadmium (TR), Cementitious material (e.g. concrete) (3.41%), Copper (TR), Fabric (TR), Fibreglass (0.08%), Glass (0.03%), Gypsum Plasterboard/ Fibreboard (0.06%), Lead (1.88%), Mild Steel (17.79%), Oil (TR), Other (1.22%), Paper (13.33%), Plastic (45.72%), Rubber (6.99%), Sand (0.07%), Sources (TR), Stainless steel (0.54%), Titanium (0.01%), WEEE containing hazardous components (0.01%), WEEE not containing hazardous components (0.04%), Wood/ Wood composite (6.04%),

Chemical state: Neutral

Sheet metal proportion / thickness: 1.64% 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.
0.08% 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.....	= 0.54	-	
Other ferrous metals.....	= 17.8	mild steel	
Iron.....	= 0	-	
Aluminium.....	= 0.77	-	
Beryllium.....	= 0	-	
Cobalt.....	= 0	-	
Copper.....	= 0.01	-	
Lead.....	= 1.9	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	= 0	-	
Titanium.....	= 0.01	-	
Uranium.....	= 0	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	= 0.05	Cadmium 0.00%, Sources 0.00%, WEEE containing hazardous components 0.01%, WEEE not containing hazardous components 0.04%,	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 19.4	-	
Paper, cotton.....	= 13.3	-	
Wood.....	= 6.0	-	
Halogenated plastics.....	= 22.9	-	
Total non-halogenated plastics.....	= 22.9	-	
Condensation polymers.....	NE	-	
Others.....	NE	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	= 7.0	-	
Halogenated rubber.....	NE	-	
Non-halogenated rubber.....	NE	-	
Hydrocarbons.....	= 0.46	-	
Oil or grease.....	= 0.01	-	
Fuel.....	NE	-	
Asphalt/Tarmac (cont.coal tar).....	= 0	-	
Asphalt/Tarmac (no coal tar).....	= 0.45	-	
Bitumen.....	= 0	-	
Others.....	NE	-	
Other organics.....	= 1.2	Other 1.22%,	

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.....	= 1.5	includes plasterboard	
Cementitious material.....	= 3.4	-	
Sand.....	= 0.07	-	
Glass/Ceramics.....	= 0.11	Glass 0.03%, Fibreglass 0.08%,	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	= 0	-	
Asbestos.....	= 0.15	Asbestos may be present however Friability not known at this time	
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.....	= 0	-
Chloride.....	NE	-
Iodide.....	NE	-
Cyanide.....	= 0	-
Carbonate.....	NE	-
Nitrate.....	NE	-
Nitrite.....	NE	-
Phosphate.....	= 0	-
Sulphate.....	= 0.06	-
Sulphide.....	NE	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	NE	-
Low flash point liquids.....	NE	-
Explosive materials.....	NE	-
Phosphorus.....	NE	-
Hydrides.....	NE	-
Biological etc. materials.....	NE	-
Biodegradable materials.....	= 0	-
Putrescible wastes.....	NE	-
Non-putrescible wastes.....	NE	-
Corrosive materials.....	NE	-
Pyrophoric materials.....	NE	-
Generating toxic gases.....	NE	-
Reacting with water.....	= 0	-
Higher activity particles.....	NE	-
Soluble solids as bulk chemical compounds.....	NE	-

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	NE	-
Benzene.....	= 0	-
Chlorinated solvents.....	-	-
Formaldehyde.....	NE	-
Organometallics.....	NE	-
Phenol.....	NE	-
Styrene.....	NE	-
Tri-butyl phosphate.....	NE	-
Other organophosphates.....	NE	-
Vinyl chloride.....	NE	-
Arsenic.....	= 0	-
Barium.....	NE	-
Boron.....	= 0	-
Boron (in Boral).....	NE	-
Boron (non-Boral).....	NE	-
Cadmium.....	< 0.01	-
Caesium.....	NE	-
Selenium.....	= 0	-
Chromium.....	= 0	-
Molybdenum.....	= 0	-
Thallium.....	NE	-
Tin.....	= 0	-
Vanadium.....	= 0	-
Mercury compounds.....	= 0	-
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	Trace contamination may only be possible from potential spills of decontamination agents e.g. DECON90, GRAMOS.
Total complexing agents.....	NE	-

Physical components:

	Number	Type(s) and comment
Sources.....	3	-
Electronic & Electrical Equipment (EEE)	-	-
EEE Type 1.....	-	-
EEE Type 2.....	8	Mobile Filtration Unit, Pond infrastructure, Crane lifting arm
EEE Type 3.....	1	Diamond wire cutting unit
EEE Type 4.....	-	-
EEE Type 5.....	-	-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction	On-site	= 85.0
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application	On-site	= 100.0
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		

Comments on planned treatments:

85% of the waste stream will be supercompacted in 200L drums before being placed in HHISOs. HHISOs filled with Bulk waste, compacted drums, or a mix of both will be encapsulated before final disposal.

Conditioning method:

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

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

Dounreay uses: Cement OPC 1:3 PFA ~35% water content and plasticiser

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
Non IP-2 rated 1/2 Height ISO (DC02)	100.0	23.7	15.6	61	-

Range in container waste loading:

The waste loading value is a rough average using previously consigned waste data. Waste loading per ISO can vary significantly, based on how the container is loaded. In general, bulk items leads to a lower waste loading value where as compactable leads to a higher one. Most containers contain a mix of the two.

Other information on packaging and conditioning:

The waste will be loaded into an alternative non-IP2 rated LLW Disposal HHISO for transfer to the NRSD LLW Disposal Facility. Each HHISO may have LLW items from other waste streams in the final HHISO. The high loading volume is due to large volume of compactable waste in the waste stream.

Conditioned density (t/m³):

~ 2.0

Conditioned density comment:

This value is the midpoint between a range of densities going from 1.49-2.47. These were taken from HHISOs disposed of in NRSD LLW Disposal Vaults

Management Routes:

Disposal Route	Stream volume %	Raw density t/m ³	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: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
Dounreay LLWDV	Incineration facility	< 85.0	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 85% is theoretical maximum based on 100% drummed LLW being suitable for incineration. The 85% is subject to further review by NRS Dounreay.
Dounreay LLWDV	Metal treatment facility	~ 9.0	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 9% remains indicative and is subject to further review and characterisation by NRS Dounreay.

RADIOACTIVITY

Source: The source of radioactivity is from MTR fuel reprocessing work previously carried out in the facility (and also from other research reactors).

Uncertainty: Within a factor of three.

Measurement of radioactivities: The fingerprint for the waste will be consistent with the composition of Uranyl Nitrate product liquor which typically contained U235, U234 and U238 as the predominant radionuclides by mass. To confirm the relative compositions of these species a swab of the Product Cabinet floor and a sample of contaminated concrete were taken for analysis.

Chemical form of radionuclides:

- H-3: -
- C-14: -
- Cl-36: Not likely to be present
- Se-79: -
- Tc-99: -
- I-129: Not likely to be present
- Ra: -
- Th: -
- U: Likely to be present as oxide and/or nitrate as very low level contamination.
- Np: -
- Pu: Likely to be present as oxide and/or nitrate as very low level contamination.

WASTE STREAM 5B315 MTR Reprocessing Plant LLW									
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					Pb 205				
Fe 55					Pb 210			= 1.27E-15	C C 2
Co 60			= 3.64E-10	C C 2	Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210			= 9.72E-16	C C 2
Zn 65					Ra 223			= 4.05E-13	C C 2
Se 79					Ra 225			= 1.17E-21	C C 2
Kr 81					Ra 226			= 2.14E-14	C C 2
Kr 85					Ra 228			= 2.51E-18	C C 2
Rb 87					Ac 227			= 4.21E-13	C C 2
Sr 90			= 1.46E-05	C C 2	Th 227			= 4.05E-13	C C 2
Zr 93					Th 228			= 2.73E-08	C C 2
Nb 91					Th 229			= 1.21E-21	C C 2
Nb 92					Th 230			= 1.65E-11	C C 2
Nb 93m					Th 232			= 8.71E-18	C C 2
Nb 94					Th 234			= 4.30E-09	C C 2
Mo 93					Pa 231			= 4.69E-12	C C 2
Tc 97					Pa 233			= 5.09E-13	C C 2
Tc 99					U 232			= 3.02E-08	C C 2
Ru 106					U 233			= 6.52E-18	C C 2
Pd 107					U 234			= 2.99E-07	C C 2
Ag 108m					U 235			= 3.70E-08	C C 2
Ag 110m					U 236			= 2.94E-08	C C 2
Cd 109			= 4.44E-09	C C 2	U 238			= 4.30E-09	C C 2
Cd 113m					Np 237			= 5.18E-13	C C 2
Sn 119m					Pu 236				
Sn 121m					Pu 238			= 6.89E-07	C C 2
Sn 123					Pu 239			= 3.43E-08	C C 2
Sn 126					Pu 240			= 3.08E-08	C C 2
Sb 125			= 2.08E-09	C C 2	Pu 241			= 4.82E-07	C C 2
Sb 126					Pu 242				
Te 125m			= 4.91E-10	C C 2	Am 241			= 2.68E-07	C C 2
Te 127m					Am 242m				
I 129					Am 243			= 2.26E-12	C C 2
Cs 134			= 9.89E-10	C C 2	Cm 242				
Cs 135					Cm 243				
Cs 137			= 1.83E-05	C C 2	Cm 244			= 1.49E-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			= 4.41E-08	C C 2	Cf 251				
Sm 147			= 4.24E-18	C C 2	Cf 252				
Sm 151			= 1.94E-07	C C 2	Unsp a				
Eu 152					Unsp b/g				
Eu 154			= 8.73E-08	C C 2	Total a	0	*	1.46E-06	*
Eu 155			= 6.43E-09	C C 2	Total b/g	0	*	3.38E-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