

WASTE STREAM	5B349	Uranium Recovery 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	= 35.0		
	1.4.2026 - 31.3.2027	= 35.0		
	1.4.2027 - 31.3.2028	= 35.0		
	1.4.2028 - 31.3.2029	= 46.0		
	1.4.2029 - 31.3.2030	= 35.0		
	1.4.2030 - 31.3.2031	= 65.7		
	1.4.2031 - 31.3.2032	= 100.6		
	1.4.2032 - 31.3.2033	= 129.8		
	1.4.2033 - 31.3.2034	= 58.9		
	1.4.2034 - 31.3.2035	= 58.9		
	1.4.2035 - 31.3.2036	= 58.9		
	1.4.2036 - 31.3.2037	= 59.1		
	1.4.2037 - 31.3.2038	= 58.9		
	1.4.2038 - 31.3.2039	= 58.9		
	1.4.2039 - 31.3.2040	= 46.4		
	1.4.2040 - 31.3.2041	= 212.8		
	1.4.2041 - 31.3.2042	= 653.9		
	1.4.2068 - 31.3.2069	= 0.7		
	1.4.2069 - 31.3.2070	= 0.5		
Total future arisings:	1750.0			
Total waste volume:	1750.0			

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

Comment on arising rates: Programme data is based on NRS Dounreay's 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 Arisings will be from the decommissioning of the Uranium Recovery Plant.

PHYSICAL CHARACTERISTICS

General description: The waste will include gloveboxes, fume cupboards, plant items, flooring, tanks, ovens, panels, ventilation ducts/filters and secondary wastes.

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 (1.21%), Asbestos (0.11%), Asphalt (0.92%), Batteries and Accumulators (TR), Boron (TR), Cementitious material (e.g. concrete) (40.24%), Copper (0.58%), Fabric (TR), Fibreglass (3.16%), Glass (0.27%), Gypsum Plasterboard/ Fibreboard (2.21%), Lead (0.03%), Mild Steel (16.10%), MMF Insulation Materials (nonHaz) (0.88%), Oil (TR), Other (0.81%), Other metal (TR), Other organics (0.45%), Paper (10.81%), Plastic (10.74%), Rubber (2.16%), Sources (TR), Stainless steel (4.30%), WEEE containing hazardous components (TR), WEEE not containing hazardous components (TR), Wood/ Wood composite (4.97%), Zinc (TR), Halogenated Plastic (0.01%), Unhalogenated Plastic (TR).

Chemical state: Neutral

Sheet metal proportion / thickness: 15.15% 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.
8.09% 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.....	= 4.3	-	
Other ferrous metals.....	= 16.1	mild steel	
Iron.....	0	-	
Aluminium.....	= 1.2	-	
Beryllium.....	0	-	
Cobalt.....	0	-	
Copper.....	= 0.58	-	
Lead.....	= 0.03	-	
Magnox/Magnesium.....	0	-	
Nickel.....	0	-	
Titanium.....	0	-	
Uranium.....	0	-	
Zinc.....	< 0.01	-	
Zircaloy/Zirconium.....	0	-	
Other metals.....	= 0.01	Batteries and Accumulators 0.00%, Other metal 0.00%, Sources 0.00%, WEEE containing hazardous components 0.00%, WEEE not containing hazardous components 0.01%,	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 15.8	-	
Paper, cotton.....	= 10.8	-	
Wood.....	= 5.0	-	
Halogenated plastics.....	= 5.4	-	
Total non-halogenated plastics.....	= 5.4	-	
Condensation polymers.....	NE	-	
Others.....	NE	-	
Organic ion exchange materials.....	0	-	
Total rubber.....	= 2.2	-	
Halogenated rubber.....	NE	-	
Non-halogenated rubber.....	NE	-	
Hydrocarbons.....	= 0.92	-	
Oil or grease.....	< 0.01	-	
Fuel.....	NE	-	
Asphalt/Tarmac (cont.coal tar).....	0	-	
Asphalt/Tarmac (no coal tar).....	= 0.92	-	
Bitumen.....	0	-	
Others.....	NE	-	
Other organics.....	= 1.3	Other organics 0.45%, Other 0.81%	

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.....	= 2.2	-	
Cementitious material.....	= 40.2	inc plasterboard	
Sand.....	0	-	
Glass/Ceramics.....	= 4.3	Glass 0.27%, Fibreglass 3.16%, MMF Insulation Materials (nonHaz) 0.88%	
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.....	< 0.01	Boron 0.00%,	
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.....	= 2.2	Gypsum
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.....	NE	-
Formaldehyde.....	NE	-
Organometallics.....	NE	-
Phenol.....	NE	-
Styrene.....	NE	-
Tri-butyl phosphate.....	NE	-
Other organophosphates.....	NE	-
Vinyl chloride.....	NE	-
Arsenic.....	0	-
Barium.....	NE	-
Boron.....	< 0.01	-
Boron (in Boral).....	NE	-
Boron (non-Boral).....	NE	-
Cadmium.....	0	-
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.....		-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....		-
Other organic complexants.....		-
Total complexing agents.....	NE	-

Physical components:

	Number	Type(s) and comment
Sources.....	= 14	LLW, Solid
Electronic & Electrical Equipment (EEE)		-
EEE Type 1.....		-
EEE Type 2.....	= 5	4 gloveboxes, 1 Fumehood
EEE Type 3.....		-
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	= 17.0
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation	On-site	= 100.0
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		

Comments on planned treatments:

~17% of the waste stream will be supercompacted in 200L drums before being placed in HHISO's. HHISO's filled with bulk waste, compacted drums, or a mix of both will be encapsulated before final disposal.

Conditioning method:

LLW 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:

NRS Dounreay uses 1:3 OPC:PFA
~35% Water and plasticiser content

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	11.1	15.6	158	-

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 consist of large uncompactable items and 200 litre drums that have already been compacted. The waste will be loaded into alternative non-IP2 rated LLW Disposal HHISO for transfer for the DSRL LLW Disposal Facility. Each HHISO may have other LLW items in the final HHISO.

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 LLW DV	Incineration facility	~ 17.0	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 17% is theoretical maximum based on 100% drummed LLW being suitable for incineration. The 17% is subject to further review by NRS Dounreay.
Dounreay LLW DV	Metal treatment facility	~ 6.0	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 6% remains indicative and is subject to further review and characterisation by NRS Dounreay.

RADIOACTIVITY

Source: The material processed through the plant included material of varying enrichments ranging from depleted uranium to 93% uranium. In the absence of other information the fingerprint is assumed to be the same as that for operational wastes from the plant.

Uncertainty: Within a factor of 10 for arisings.

Measurement of radioactivities: From Consignor's records: NDA results.

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.
- Np: -
- Pu: -

WASTE STREAM 5B349 Uranium Recovery Plant LLW									
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			= 1.37E-07	C C 2	Gd 153				
Be 10					Ho 163				
C 14			= 2.76E-09	C C 2	Ho 166m				
Na 22			= 3.14E-11	C C 2	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			= 1.22E-10	C C 2
Co 60			= 8.28E-09	C C 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			= 4.21E-10	C C 2	Po 210			= 1.11E-10	C C 2
Zn 65					Ra 223			= 9.87E-15	C C 2
Se 79					Ra 225			= 1.90E-19	C C 2
Kr 81					Ra 226			= 7.14E-10	C C 2
Kr 85					Ra 228			= 3.99E-12	C C 2
Rb 87					Ac 227			= 1.03E-14	C C 2
Sr 90			= 3.60E-05	C C 2	Th 227			= 9.88E-15	C C 2
Zr 93					Th 228			= 2.00E-11	C C 2
Nb 91					Th 229			= 1.93E-19	C C 2
Nb 92					Th 230			= 1.94E-12	C C 2
Nb 93m			= 3.34E-06	C C 2	Th 232			= 7.75E-12	C C 2
Nb 94					Th 234			= 1.93E-10	C C 2
Mo 93			= 3.43E-06	C C 2	Pa 231			= 1.14E-13	C C 2
Tc 97					Pa 233			= 2.72E-11	C C 2
Tc 99			= 2.78E-08	C C 2	U 232			= 1.83E-11	C C 2
Ru 106			= 3.09E-13	C C 2	U 233			= 8.09E-16	C C 2
Pd 107					U 234			= 3.52E-08	C C 2
Ag 108m					U 235			= 9.02E-10	C C 2
Ag 110m					U 236			= 4.39E-09	C C 2
Cd 109			= 1.12E-11	C C 2	U 238			= 1.93E-10	C C 2
Cd 113m					Np 237			= 2.72E-11	C C 2
Sn 119m					Pu 236				
Sn 121m			= 2.58E-08	C C 2	Pu 238			= 4.87E-08	C C 2
Sn 123					Pu 239			= 3.83E-08	C C 2
Sn 126					Pu 240			= 3.55E-08	C C 2
Sb 125			= 1.08E-10	C C 2	Pu 241			= 1.69E-07	C C 2
Sb 126					Pu 242			= 5.35E-10	C C 2
Te 125m			= 2.55E-11	C C 2	Am 241			= 1.01E-07	C C 2
Te 127m					Am 242m			= 6.12E-11	C C 2
I 129					Am 243			= 1.17E-17	C C 2
Cs 134			= 3.74E-11	C C 2	Cm 242			= 5.11E-11	C C 2
Cs 135					Cm 243			= 8.10E-12	C C 2
Cs 137			= 3.85E-05	C C 2	Cm 244			= 3.51E-10	C C 2
Ba 133			= 4.05E-11	C C 2	Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147			= 9.04E-10	C C 2	Cf 251				
Sm 147			= 8.68E-20	C C 2	Cf 252				
Sm 151			= 1.43E-07	C C 2	Unsp a				
Eu 152			= 3.78E-09	C C 2	Unsp b/g				
Eu 154			= 2.13E-08	C C 2	Total a	0	*	2.66E-07	*
Eu 155			= 3.38E-10	C C 2	Total b/g	0	*	8.18E-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