

WASTE STREAM	5B16	Bulk Operational 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	= 3095.1		
Future arisings:				
Total future arisings:		0.0		
Total waste volume:		3095.1		

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

Comment on arising rates: This waste stream captures all Bulk LLW which is packaged and then loaded into containers for storage awaiting disposal. Future arisings are not reported to avoid double counting, as future arisings are captured within the waste streams from which the waste originates. These waste streams are: 5B301, 5B303, 5B305, 5B307, 5B309, 5B311, 5B313, 5B315, 5B329, 5B331, 5B333, 5B335, 5B337, 5B339, 5B341, 5B343, 5B345, 5B348, 5B349, 5B351, 5B352, and 5B358.

Additional information on quantities: The decrease in stock since 2022 relates to bulk waste which has been encapsulated for disposal. Previous estimates have been based on container numbers and internal /external container volumes. This estimate is based on individual package data. Some uncertainty will arise as this waste stream contains historical waste packages with outdated / incomplete waste records.

Uncertainty factors on volumes:

Stock (upper):	x 1.02	Arisings (upper):	x -
Stock (lower):	x 0.98	Arisings (lower):	x -

WASTE SOURCE Large items of waste from reactor and reprocessing operations and support facilities.

PHYSICAL CHARACTERISTICS

General description: Gloveboxes, ducting and other redundant bulk wastes that cannot be further size reduced into 200 l drums.

Changes since waste generated: The waste has been packaged into disposal containers.

Bulk density (t/m³): = 1.2

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 (0.64%), Brick/Rubble (1.95%), Cementitious material (e.g. concrete) (3.63%), Copper (0.05%), Lead (0.41%), Mild Steel (41.55%), Other (9.39%), Paper (14.86%), Rubber (4.44%), Wood/ Wood composite (4.82%), Halogenated Plastic (3.24%), Unhalogenated Plastic (15.01%),

Chemical state: Neutral

Sheet metal proportion / thickness: The waste is unsuitable for further treatment. Therefore, the proportion of sheet metal has not been assessed.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0	-	
Other ferrous metals.....	= 41.6	-	
Iron.....	= 0	-	
Aluminium.....	= 0.64	-	
Beryllium.....	= 0	-	
Cobalt.....	= 0	-	
Copper.....	= 0.05	-	
Lead.....	= 0.41	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	= 0	-	
Titanium.....	= 0	-	
Uranium.....	= 0	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	= 0	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 19.7	-	
Paper, cotton.....	= 14.9	-	
Wood.....	= 4.8	-	
Halogenated plastics.....	= 3.2	-	
Total non-halogenated plastics.....	= 15.0	-	
Condensation polymers.....	NE	-	
Others.....	NE	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	= 4.4	-	
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.....	NE	-	
Other organics.....	= 9.4	Other 9.39%,	

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.....	= 2.0	Inc plasterboard	
Cementitious material.....	= 3.6	-	
Sand.....	= 0	-	
Glass/Ceramics.....	= 0	-	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	= 0	-	
Asbestos.....	= 0	-	
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	-
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	-
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):

No		
	(%wt)	Type(s) and comment
EDTA.....	NE	-
DPTA.....	NE	-
NTA.....	NE	-
Polycarboxylic acids.....	NE	-
Other organic complexants.....	NE	-
Total complexing agents.....	= 0	-

Physical components:

	Number	Type(s) and comment
Sources.....	NE	-
Electronic & Electrical Equipment (EEE)		
EEE Type 1.....	NE	-
EEE Type 2.....	NE	-
EEE Type 3.....	NE	-
EEE Type 4.....	NE	-
EEE Type 5.....	NE	-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction	On-site	= 100.0
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		

Comments on planned treatments:

Bulk wastes in HHISO containers will be encapsulated at the grout plant prior to emplacement within the LLW Vault. HHISOs containing tritiated steel will be decay stored and sent off site for further treatment.

Conditioning method:

LLW will be grouted into non IP rated HHISOs through a dedicated grouting facility. HHISOs containing tritiated waste will be decay stored before being sent off site for Metal Treatment.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

Dounreay used: Cement OPC1:3 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	7.8	15.6	398	-

Range in container waste loading:

Other information on packaging and conditioning: This waste consists of large items of non-compactable waste. NRS Dounreay has developed a non-IP2 HHISO for use specifically at Dounreay. Work may be undertaken to explore if a non-containerised route for disposal at Dounreay may be required.

Conditioned density (t/m³): = 2.0
Conditioned density comment: -

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: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
Dounreay LLWDV	Metal treatment facility	< 67.8	RED	Opportunity for further identification of LLW in stores to be treated offsite instead of going for disposal. The metallic waste treatment route % remains indicative and is subject to further review and characterisation by NRS Dounreay. However, it should be noted that this waste has already been consigned with the intention of going into the Dounreay LLW Vaults therefore confidence level is low.

RADIOACTIVITY

Source: This waste originates from a wide variety of activities on site including reactor operations, fuel reprocessing and general site activities. It will therefore contain a mixture of fission products and activation products

Uncertainty: Within a factor of three.

Measurement of radioactivities: The specific activities have been derived from using a summation of consignor's declarations divided by the total declared volumes. Stocks decayed based on the period starting on the average date when waste was consigned.

Chemical form of radionuclides: H-3: Tritiated steel is present.
C-14: May be present at low concentrations.
Cl-36: May be present at low concentrations.
Se-79: -
Tc-99: May be present at low concentrations.
I-129: May be present at low concentrations.
Ra: May be present at low concentrations.
Th: May be present at low concentrations.
U: Likely to be present as oxide, nitrate or metal.
Np: May be present at low concentrations.
Pu: Likely to be present as oxide, nitrate or metal.

WASTE STREAM 5B16 Bulk Operational 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	= 4.08E-05	B B 2			Gd 153				
Be 10					Ho 163				
C 14	= 1.88E-06	B B 2			Ho 166m				
Na 22	= 3.07E-08	B B 2			Tm 170				
Al 26					Tm 171				
Cl 36	= 2.41E-11	B B 2			Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40	= 5.37E-12	B B 2			Hf 182				
Ca 41					Pt 193				
Mn 53					Ti 204				
Mn 54	= 1.66E-10	B B 2			Pb 205				
Fe 55	= 2.36E-09	B B 2			Pb 210	= 1.51E-11	B B 2		
Co 60	= 3.22E-06	B B 2			Bi 208				
Ni 59					Bi 210m				
Ni 63	= 1.66E-08	B B 2			Po 210	= 1.42E-11	B B 2		
Zn 65	= 1.22E-17	B B 2			Ra 223	= 3.49E-12	B B 2		
Se 79					Ra 225	= 4.39E-18	B B 2		
Kr 81					Ra 226	= 6.93E-11	B B 2		
Kr 85					Ra 228	= 7.80E-10	B B 2		
Rb 87					Ac 227	= 3.63E-12	B B 2		
Sr 90	= 1.90E-05	B B 2			Th 227	= 3.50E-12	B B 2		
Zr 93					Th 228	= 3.89E-09	B B 2		
Nb 91					Th 229	= 4.43E-18	B B 2		
Nb 92					Th 230	= 5.93E-10	B B 2		
Nb 93m	= 2.49E-07	B B 2			Th 232	= 1.16E-09	B B 2		
Nb 94	= 5.69E-09	B B 2			Th 234	= 9.70E-08	B B 2		
Mo 93	= 2.56E-07	B B 2			Pa 231	= 4.05E-11	B B 2		
Tc 97					Pa 233	= 8.28E-12	B B 2		
Tc 99	= 2.09E-09	B B 2			U 232	= 3.55E-09	B B 2		
Ru 106	= 7.51E-10	B B 2			U 233	= 7.94E-15	B B 2		
Pd 107					U 234	= 1.07E-05	B B 2		
Ag 108m	= 1.81E-10	B B 2			U 235	= 3.19E-07	B B 2		
Ag 110m					U 236	= 7.55E-07	B B 2		
Cd 109	= 1.47E-10	B B 2			U 238	= 9.70E-08	B B 2		
Cd 113m					Np 237	= 8.35E-12	B B 2		
Sn 119m					Pu 236				
Sn 121m	= 1.93E-09	B B 2			Pu 238	= 9.97E-07	B B 2		
Sn 123					Pu 239	= 1.66E-06	B B 2		
Sn 126					Pu 240	= 1.76E-06	B B 2		
Sb 125	= 2.28E-08	B B 2			Pu 241	= 3.04E-05	B B 2		
Sb 126					Pu 242	= 1.56E-08	B B 2		
Te 125m	= 5.39E-09	B B 2			Am 241	= 2.10E-06	B B 2		
Te 127m					Am 242m	= 2.22E-08	B B 2		
I 129					Am 243	= 5.27E-13	B B 2		
Cs 134	= 2.79E-08	B B 2			Cm 242	= 1.85E-08	B B 2		
Cs 135					Cm 243	= 4.19E-09	B B 2		
Cs 137	= 6.47E-05	B B 2			Cm 244	= 6.32E-08	B B 2		
Ba 133	= 2.04E-09	B B 2			Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	= 9.56E-14	B B 2			Cf 249				
Pm 145					Cf 250				
Pm 147	= 6.53E-07	B B 2			Cf 251				
Sm 147	= 6.28E-17	B B 2			Cf 252				
Sm 151	= 3.88E-07	B B 2			Unsp a				
Eu 152	= 9.94E-07	B B 2			Unsp b/g				
Eu 154	= 8.98E-07	B B 2			Total a	1.86E-05	*	0	*
Eu 155	= 1.00E-07	B B 2			Total b/g	1.64E-04	*	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 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