

WASTE STREAM	5B358	Previously Disposed LLW to be Retrieved
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SITE Dounreay

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Dounreay Site Restoration Limited

WASTE TYPE LLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m ³
Future arisings -	1.4.2030 - 31.3.2031.....	4355.9 m ³
	1.4.2031 - 31.3.2032.....	6162.4 m ³
	1.4.2032 - 31.3.2033.....	6179.3 m ³
	1.4.2033 - 31.3.2034.....	6162.4 m ³
	1.4.2034 - 31.3.2035.....	6162.4 m ³
	1.4.2035 - 31.3.2036.....	6162.4 m ³
	1.4.2036 - 31.3.2037.....	1705.2 m ³
Total future arisings:		36890.0 m ³
Total waste volume:		36890.0 m ³

Comment on volumes: Approximately 33,620 m³ of waste has been previously disposed to the old LLW facility. However, it is also expected that the full capacity of each pit will be excavated, leading to a small increase in volume. The current strategy is to retrieve this waste and to repackage it before consigning it to the new LLW Facilities. Previous inventories assumed that half of the waste could be consigned as exempt waste however this waste category no longer exists and all the waste is now assumed to be consigned as LLW. The volume is based on historical disposal records.

Uncertainty factors on volumes:

Stock (upper):	x	Arisings (upper)	x 1.2
Stock (lower):	x	Arisings (lower)	x 0.8

WASTE SOURCE

Historically LLW was disposed of to shallow burial facilities at Dounreay. These facilities do not meet current standards and it is anticipated that the waste will be retrieved, packaged into disposal containers and consigned to the new LLW facilities.

PHYSICAL CHARACTERISTICS

General description: There is little detailed information available on the physical and chemical characteristics of the Pits wastes in addition to that given below. The types of waste disposed of comprises: building rubble; process plant material; protective materials (PVC and rubber gloves); metals; incinerator ash; cemented sludge; glassware; plastic; fabric; wood; paper and cardboard; filter materials (may contain some wood pulp); and low specific activity scale. The volumes of putrescible materials are low and amounts of methane generated through waste degradation are also expected to be low, especially since a LLW incinerator was operated from 1959 to 1997.

Physical components (%vol): It is estimated that by volume there is 24% building rubble, 6% ash and filters, 40% PVC and rubber gloves and 30% metals (mostly steel and some lead bricks).

Sealed sources: Not yet determined.

Bulk density (t/m³): ~1

Comment on density: The density is estimated to be around 1 te/m³, though no exact information is available.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless steel (25%), other ferrous metals (25%), aluminium (0.13%), copper (1%), lead (5%), asbestos (2.15%), halogenated plastics (1.2%), non-halogenated plastics (2.3%), halogenated rubber (2.6%), cementitious rubble (26.8%), glass (8.5%), others (0.32%).

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Chemical state: Neutral

Chemical form of radionuclides: Cl-36: Not likely to be present.
 Se-79: May be present as contamination.
 Tc-99: May be present as contamination.
 I-129: May be present in very small quantities.
 Ra: May be present as contamination.
 Th: May be present as contamination.
 U: May be present as contamination.
 Np: May be present as contamination.
 Pu: May be present as contamination.

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~25.0		
Other ferrous metals.....	~25.0		
Iron.....			
Aluminium.....	~0.13		
Beryllium.....	TR		
Cobalt.....	0		
Copper.....	~1.0		
Lead.....	~5.0		
Magnox/Magnesium.....	0		
Nickel.....			
Titanium.....			
Uranium.....	P		
Zinc.....	NE		
Zircaloy/Zirconium.....	NE		
Other metals.....	0.32	Other metals may be present	

Organics (%wt): PVC sheets and bags. and Neoprene gloves.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	TR		
Paper, cotton.....	TR		
Wood.....	TR		
Halogenated plastics	~1.2		
Total non-halogenated plastics.....	~2.3		
Condensation polymers.....	NE		
Others.....	~2.3		
Organic ion exchange materials....	0		
Total rubber.....	~2.6		
Halogenated rubber	~2.6		
Non-halogenated rubber.....	NE		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			

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Bitumen.....
 Others.....
 Other organics..... P

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	TR		
Brick/Stone/Rubble.....	NE		
Cementitious material.....	~26.8		
Sand.....			
Glass/Ceramics.....	~8.5		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	2.2		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): Possibly associated with trace contaminated items from potential historical spillages etc.

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	0	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	0	
Nitrate.....	TR	
Nitrite.....	0	
Phosphate.....	TR	
Sulphate.....	0	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: Asbestos is present at about 2.15%.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	

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Biological etc. materials.....	0
Biodegradable materials.....	0
Putrescible wastes.....	0
Non-putrescible wastes.....	
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	NE
Soluble solids as bulk chemical compounds.....	NE

Hazardous substances / non hazardous pollutants: Some lead is known to be present.

	(%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.....	TR	
Caesium.....		
Selenium.....	NE	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....		
Tin.....	NE	
Vanadium.....	NE	
Mercury compounds.....		
Others.....	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		
EEE Type 2.....		
EEE Type 3.....		

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EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt): Not yet determined

(%wt) Type(s) and comment

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Possibly associated with potential historical spillages.

Total complexing agents..... TR

Potential for the waste to contain discrete items: Yes. Photographic evidence of discrete bulk items

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None		100.0

Comment on planned treatments:

The treatment of the waste has not yet been fully determined, although it is anticipated that a range of characterisation and treatment options will be deployed. This may lead to alternative waste route options being available. Exact options will be identified as project progresses.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known	100.0	1.0

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

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

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Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be consigned to an On-Site Disposal Facility			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be consigned as Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Onsite disposal	Onsite disposal	100.0	31/03/2032	Medium	DSRL site reference position is to retrieve the LLW pits waste however an opportunity exists for the waste to remain in situ.

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m ³	Number of packages
1/3 Height IP-1 ISO	100.0	10	3689
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO			
1/2 Height IP-2 Disposal/Re-usable ISO			
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: DSRL now uses a non IP2 rated alternative HHISO container for use between DSRL site and the LLW Disposal Facility.

Waste Planned for Disposal at the LLW Repository: (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: -

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: Radionuclide Specific Activity data was taken from NLLWF/3/REP/GAL/0985/IS/02 - Table 10.1. This information has come from a comparison of older studies, borehole sample data, and DRWI 2012.

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Uncertainty:	Within a factor of three.
Definition of total alpha and total beta/gamma:	Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.
Measurement of radioactivities:	Radionuclide data was divided by the total volume of the LLW Pits. It has also been decayed from 2014 (the year of the Galsons report) to 2022
Other information:	There are no unlisted radionuclides present at significant concentrations.

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	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					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210		1.34E-07	BB 2	
Co 60			6.51E-08	BB 2	Bi 208				
Ni 59			4.01E-08	BB 2	Bi 210m				
Ni 63			2.80E-06	BB 2	Po 210		1.3E-07	BB 2	
Zn 65					Ra 223				
Se 79			7.73E-10	BB 2	Ra 225				
Kr 81					Ra 226		2.92E-07	BB 2	
Kr 85					Ra 228		8.04E-09	BB 2	
Rb 87					Ac 227		5.02E-12	BB 2	
Sr 90			5.54E-05	BB 2	Th 227				
Zr 93			5.07E-09	BB 2	Th 228		1.18E-08	BB 2	
Nb 91					Th 229		5.37E-18	BB 2	
Nb 92					Th 230		6.94E-10	BB 2	
Nb 93m			3.77E-09	BB 2	Th 232		2.50E-16	BB 2	
Nb 94			1.22E-08	BB 2	Th 234				
Mo 93					Pa 231		4.46E-11	BB 2	
Tc 97					Pa 233				
Tc 99			3.33E-08	BB 2	U 232				
Ru 106					U 233		9.00E-15	BB 2	
Pd 107			4.69E-10	BB 2	U 234		1.08E-05	BB 2	
Ag 108m					U 235		3.01E-07	BB 2	
Ag 110m					U 236		7.24E-07	BB 2	
Cd 109					U 238		1.05E-07	BB 2	
Cd 113m					Np 237		3.48E-11	BB 2	
Sn 119m					Pu 236				
Sn 121m					Pu 238		2.30E-06	BB 2	
Sn 123					Pu 239		1.68E-05	BB 2	
Sn 126			5.69E-09	BB 2	Pu 240		6.51E-06	BB 2	
Sb 125			1.12E-10	BB 2	Pu 241		5.57E-05	BB 2	
Sb 126					Pu 242		2.52E-09	BB 2	
Te 125m					Am 241		7.40E-06	BB 2	
Te 127m					Am 242m		7.83E-08	BB 2	
I 129			6.26E-11	BB 2	Am 243				
Cs 134			1.53E-11	BB 2	Cm 242		6.47E-08	BB 2	
Cs 135			3.33E-09	BB 2	Cm 243				
Cs 137			7.05E-05	BB 2	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147			2.69E-09	BB 2	Cf 251				
Sm 147			5.01E-18	BB 2	Cf 252				
Sm 151			5.00E-06	BB 2	Other a				
Eu 152			8.11E-06	BB 2	Other b/g				
Eu 154			2.64E-07	BB 2	Total a	0	4.54E-05	BB 2	
Eu 155			2.82E-08	BB 2	Total b/g	0	1.98E-04	BB 2	

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 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