

<b>WASTE STREAM</b>	<b>5B313</b>	<b>HAL Store and Evaporation Plant LLW</b>
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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 <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2023.....	25.9 m <sup>3</sup>
	1.4.2023 - 31.3.2024.....	25.9 m <sup>3</sup>
	1.4.2024 - 31.3.2025.....	26.0 m <sup>3</sup>
	1.4.2025 - 31.3.2026.....	25.9 m <sup>3</sup>
	1.4.2026 - 31.3.2027.....	25.9 m <sup>3</sup>
	1.4.2027 - 31.3.2028.....	25.9 m <sup>3</sup>
	1.4.2028 - 31.3.2029.....	26.0 m <sup>3</sup>
	1.4.2029 - 31.3.2030.....	25.9 m <sup>3</sup>
	1.4.2030 - 31.3.2031.....	25.9 m <sup>3</sup>
	1.4.2031 - 31.3.2032.....	37.4 m <sup>3</sup>
	1.4.2032 - 31.3.2033.....	48.3 m <sup>3</sup>
	1.4.2033 - 31.3.2034.....	48.2 m <sup>3</sup>
	1.4.2034 - 31.3.2035.....	48.2 m <sup>3</sup>
	1.4.2035 - 31.3.2036.....	48.2 m <sup>3</sup>
	1.4.2036 - 31.3.2037.....	48.3 m <sup>3</sup>
	1.4.2037 - 31.3.2038.....	48.2 m <sup>3</sup>
	1.4.2038 - 31.3.2039.....	48.2 m <sup>3</sup>
	1.4.2039 - 31.3.2040.....	48.2 m <sup>3</sup>
	1.4.2040 - 31.3.2041.....	58.8 m <sup>3</sup>
	1.4.2041 - 31.3.2042.....	68.8 m <sup>3</sup>
	1.4.2042 - 31.3.2043.....	27.9 m <sup>3</sup>
Total future arisings:		812.0 m <sup>3</sup>
Total waste volume:		812.0 m <sup>3</sup>

Comment on volumes: It should be noted that the DSRL site programme is currently under review and future arisings dates are subject to change. The arisings were revised in line with the plant waste inventory walk round exercise. Stocks will be captured under 5B15 and 5B16. A new decommissioning study is being undertaken which may impact on this waste stream.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.2  
 Stock (lower): x Arisings (lower) x 0.8

**WASTE SOURCE** Demolished vessels, pipework and associated civil works from general plant decommissioning.

**PHYSICAL CHARACTERISTICS**

General description: Waste is mostly building materials (cells) with smaller amounts of metal, plastic, rubber etc. Large items will be size reduced during decommissioning.  
 Physical components (%vol): Asphalt (0.02%), Cementitious material (e.g. concrete) (15.13%), Fibreglass (2.91%), Lead (1.40%), Mild Steel (15.24%), Other (2.52%), Paper (25.91%), Plastic (22.62%), Rubber (4.39%), Stainless steel (7.68%), Wood/ Wood composite (2.14%), Paper / Cardboard (0.02%),  
 Sealed sources: Not yet determined.  
 Bulk density (t/m<sup>3</sup>): 0.28  
 Comment on density: The bulk density is based on D3100 Disposl Inventory Report - 2020

**CHEMICAL COMPOSITION**

General description and components (%wt): Asphalt (0.02%), Cementitious material (e.g. concrete) (12.42%), Fibreglass (2.61%), Lead (5.43%), Mild Steel (40.98%), Other (0.86%), Paper (7.09%), Plastic (7.12%), Rubber

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(2.28%), Stainless steel (20.66%), Wood/ Wood composite (0.52%),

Chemical state: Neutral

Chemical form of radionuclides: H-3: Potentially present but at very low concentrations.  
 C-14: Potentially present but at very low concentrations.  
 Cl-36: Not likely to be present  
 Se-79: Potentially present but at very low concentrations.  
 Tc-99: Potentially present but at very low concentrations.  
 I-129: Potentially present but at very low concentrations.  
 Ra: Potentially present but at very low concentrations  
 Th: Potentially present but at very low concentrations  
 U: Present at low concentrations as contamination (nitrate).  
 Np: Potentially present but at very low concentrations.  
 Pu: Present at low concentrations as contamination (nitrate).

Metals and alloys (%wt): Metal in various shapes and thicknesses as items of process plant.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	20.7		
Other ferrous metals.....	41.0		
Iron.....			
Aluminium.....	TR		
Beryllium.....			
Cobalt.....	0		
Copper.....	TR		
Lead.....	5.4		
Magnox/Magnesium.....	0		
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	TR		
Zircaloy/Zirconium.....	0		
Other metals.....	0.87		

Organics (%wt): The waste contains halogenated and non-halogenated plastic, rubber and paper.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	7.6		
Paper, cotton.....	7.1		
Wood.....	0.52		
Halogenated plastics .....			
Total non-halogenated plastics.....	7.1		
Condensation polymers.....			
Others.....			
Organic ion exchange materials....	0		
Total rubber.....	2.3		
Halogenated rubber .....	1.1		
Non-halogenated rubber.....	1.1		
Hydrocarbons.....	0.02		
Oil or grease .....			
Fuel.....			

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Asphalt/Tarmac (cont.coal tar)... 0.01

Asphalt/Tarmac (no coal tar).... 0.01

Bitumen.....

Others.....

Other organics.....

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..			
Inorganic sludges and flocs.....			
Soil.....			
Brick/Stone/Rubble.....			
Cementitious material.....	12.4	Cementitious material	
Sand.....			
Glass/Ceramics.....	2.6	Fibreglass	
Graphite.....			
Desiccants/Catalysts.....			
Asbestos.....			
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....			
Free non-aqueous liquids.....			
Powder/Ash.....			

Inorganic anions (%wt): Trace quantities of inorganic anions may be present dependent on operations undertaken.

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

Materials of interest for waste acceptance criteria: Asbestos is likely to be present.

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	(%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.....	0	
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:      Lead is 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.....	NE	
Caesium.....		
Selenium.....	NE	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....		
Tin.....	NE	
Vanadium.....	NE	

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Mercury compounds.....  
 Others..... NE  
 Electronic Electrical Equipment (EEE)  
 EEE Type 1.....  
 EEE Type 2.....  
 EEE Type 3.....  
 EEE Type 4.....  
 EEE Type 5.....

Complexing agents (%wt): No

(%wt) Type(s) and comment  
 EDTA.....  
 DPTA.....  
 NTA.....  
 Polycarboxylic acids.....  
 Other organic complexants.....  
 Total complexing agents..... 0

Potential for the waste to contain discrete items: Yes. The waste has the POTENTIAL to contain durable engineered items and/or contaminated hand tools.

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	66.0
Supercompaction (HFC)		
Incineration	On-site	100.0
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		

Comment on planned treatments:

Uncompacted drums will be supercompacted before being placed in HHISOs. The waste will be encapsulated before final disposal. DSRL has begun trailing alternative waste treatment routes in particular Metal Treatment. These opportunities, however, are not yet fully established waste routes.

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	100.0	
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		

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	Incineration	65.0	-	Low	This opportunity is still at an early stage of development. A small scale trial is expected to take place in FY22/23. The timing is dependent on the non-containerised waste tasks which will generate the wastes.
Onsite disposal	Metal treatment	10.0	2022	High	Trial is underway to open the Metal Treatment Route.

**Waste Packaging for Disposal:**

Container	Stream volume %	Waste loading m <sup>3</sup>	Number of packages
1/3 Height IP-1 ISO 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	100.0	16	51

Other information: The waste will be loaded into an alternative non-IP2 rated LLW Disposal HHISO for transfer to the DSRL LLW Disposal Facility. Each HHISO may have LLW items from other wastestreams in the final HHISO.

**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: No.

**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:	Contaminated/activated items/concrete from HAL storage plant.
Uncertainty:	Within a factor of ten.
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:	From Consignor's records
Other information:	Specific activity has been taken from 2019 UKRWI decayed to 2022

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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				
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90			7.97E-06	CC 2	Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99			1.92E-08	CC 2	U 232		1.14E-11	CC 2	
Ru 106			1.44E-09	CC 2	U 233		2.01E-12	CC 2	
Pd 107					U 234		4.66E-08	CC 2	
Ag 108m					U 235		8.79E-12	CC 2	
Ag 110m					U 236		1.86E-11	CC 2	
Cd 109					U 238		6.33E-09	CC 2	
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238		9.17E-06	CC 2	
Sn 123					Pu 239		5.97E-07	CC 2	
Sn 126					Pu 240		6.06E-07	CC 2	
Sb 125			2.91E-09	CC 2	Pu 241		1.32E-05	CC 2	
Sb 126					Pu 242				
Te 125m			6.49E-10	CC 2	Am 241		2.53E-06	CC 2	
Te 127m					Am 242m		1.20E-07	CC 2	
I 129					Am 243		3.77E-09	CC 2	
Cs 134			2.41E-09	CC 2	Cm 242		1.00E-07	CC 2	
Cs 135					Cm 243		2.58E-08	CC 2	
Cs 137			2.34E-05	CC 2	Cm 244		7.91E-08	CC 2	
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147			2.61E-07	CC 2	Cf 251				
Sm 147			2.90E-18	CC 2	Cf 252				
Sm 151			1.19E-06	CC 2	Other a				
Eu 152					Other b/g				
Eu 154			3.49E-07	CC 2	<b>Total a</b>	<b>0</b>	<b>1.32E-05</b>	<b>CC 2</b>	
Eu 155			4.43E-07	CC 2	<b>Total b/g</b>	<b>0</b>	<b>4.70E-05</b>	<b>CC 2</b>	

**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