

<b>WASTE STREAM</b>	<b>5B314</b>	<b>HAL Store and Evaporation Plant ILW</b>
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**SITE** Dounreay  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Dounreay Site Restoration Limited  
**WASTE TYPE** ILW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0.1 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2024.....	129.0 m <sup>3</sup>
Total future arisings:		129.0 m <sup>3</sup>
Total waste volume:		129.1 m <sup>3</sup>

Comment on volumes: It should be noted that the DSRL site programme is currently under review and arisings dates are subject to change. Arisings revised in line with plant waste inventory walk round exercise.

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

**WASTE SOURCE** Decommissioning of a high active liquid storage and treatment facility.

**PHYSICAL CHARACTERISTICS**

General description: Demolished chemical plant, vessels and pipework. Large items will be size reduced during decommissioning.  
 Physical components (%vol): Cementitious material (e.g. concrete) (2.24%), Lead (5.97%), Mild Steel (15.18%), Other (0.04%), Plastic (0.04%), Stainless steel (76.53%),  
 Sealed sources: Not yet determined.  
 Bulk density (t/m<sup>3</sup>): 0.48  
 Comment on density: The bulk density is based on consignor's records.

**CHEMICAL COMPOSITION**

General description and components (%wt): Cementitious material (e.g. concrete) (0.68%), Lead (8.50%), Mild Steel (15.03%), Stainless steel (75.78%), other metals (0.01%)

Chemical state: Neutral

Chemical form of radionuclides:  
 H-3: May be present at low concentrations.  
 C-14: May be present at low concentrations.  
 Cl-36: May be present at low concentrations.  
 Se-79: May be present at low concentrations.  
 Tc-99: May be present at low concentrations.  
 I-129: May be present at low concentrations.  
 Ra: Not known to be present.  
 Th: May be present at low concentrations.  
 U: Present as nitrate.  
 Np: May be present at low concentrations.  
 Pu: Present as nitrate.

Metals and alloys (%wt): Metallic items are process plant of varying thickness and shape, mainly stainless steel.

Stainless steel.....	75.8
Other ferrous metals.....	15.0
Iron.....	
Aluminium.....	0
Beryllium.....	P
Cobalt.....	0
Copper.....	0
Lead.....	8.5
Magnox/Magnesium.....	0

**WASTE STREAM**

**5B314**

**HAL Store and Evaporation Plant ILW**

	Nickel.....		
	Titanium.....		
	Uranium.....	P	
	Zinc.....	0	
	Zircaloy/Zirconium.....	0	
	Other metals.....	0.01	Adjust
Organics (%wt):	-		
	Total cellulose.....	TR	
	Paper, cotton.....	TR	
	Wood.....	TR	
	Halogenated plastics .....	TR	
	Total non-halogenated plastics.....	TR	
	Condensation polymers.....	NE	
	Others.....	TR	
	Organic ion exchange materials....	0	
	Total rubber.....	0	
	Halogenated rubber .....	0	
	Non-halogenated rubber.....	0	
	Hydrocarbons.....		
	Oil or grease .....		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	0	
Other materials (%wt):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	NE	
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	0.68	
	Sand.....		
	Glass/Ceramics.....		
	Graphite.....	0	
	Desiccants/Catalysts.....		
	Asbestos.....	NE	
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	NE	
	Free non-aqueous liquids.....	NE	
	Powder/Ash.....	NE	

**WASTE STREAM****5B314****HAL Store and Evaporation Plant ILW**

Inorganic anions (%wt):

Inorganic anions may be present.

Fluoride.....	NE
Chloride.....	NE
Iodide.....	NE
Cyanide.....	0
Carbonate.....	NE
Nitrate.....	P
Nitrite.....	TR
Phosphate.....	NE
Sulphate.....	NE
Sulphide.....	NE

Materials of interest for waste acceptance criteria:

It has not been determined if there are hazardous materials in the waste.

Combustible metals.....
Low flash point liquids.....
Explosive materials.....
Phosphorus.....
Hydrides.....
Biological etc. materials.....
Biodegradable materials.....
Putrescible wastes.....
Non-putrescible wastes.....
Corrosive materials.....
Pyrophoric materials.....
Generating toxic gases.....
Reacting with water.....
Active particles.....
Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants:

Toxic metals may be present at low levels, in addition to lead.

Acrylamide.....	
Benzene.....	NE
Chlorinated solvents.....	
Formaldehyde.....	
Organometallics.....	
Phenol.....	NE
Styrene.....	
Tri-butyl phosphate.....	NE
Other organophosphates.....	
Vinyl chloride.....	NE
Arsenic.....	NE
Barium.....	

<b>WASTE STREAM</b>	<b>5B314</b>	<b>HAL Store and Evaporation Plant ILW</b>
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Boron..... NE  
 Cadmium..... NE  
 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.....  
     EEE Type 4.....  
     EEE Type 5.....

Complexing agents (%wt): No  
     EDTA.....  
     DPTA.....  
     NTA.....  
     Polycarboxylic acids.....  
     Other organic complexants.....  
     Total complexing agents..... 0

**PACKAGING AND CONDITIONING**

Conditioning method: The strategy for waste packaging is still being developed but it is likely that the waste will be packaged into 6m<sup>3</sup> Concrete Boxes (High Density), depending on activity.  
 Plant Name: -  
 Location: Dounreay  
 Plant startup date: TBC  
 Total capacity (m<sup>3</sup>/y incoming waste): -  
 Target start date for packaging this stream: -  
 Throughput for this stream (m<sup>3</sup>/y incoming waste): 35.0  
 Other information: Strategy still to be confirmed. Programme dates for this facility is still to be confirmed.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	6m <sup>3</sup> concrete box (HD)	100.0	NE	5.76	NE

<b>WASTE STREAM</b>	<b>5B314</b>	<b>HAL Store and Evaporation Plant ILW</b>
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Likely container type comment: Strategy being developed including aggressive washouts to potentially change waste category.

Range in container waste volume: Not yet estimated.

Other information on containers: -

Likely conditioning matrix: Cement

Other information: -

Conditioned density (t/m<sup>3</sup>): ~2.5

Conditioned density comment: The density is likely to be around 2 - 3 t/m<sup>3</sup>.

Other information on conditioning: -

Opportunities for alternative disposal routing: No

Treatment	Stream volume (%)	Comment
-	-	-

### RADIOACTIVITY

Source: The main sources of activity are activated and contaminated equipment/structures.

Uncertainty: -

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: The fingerprint is based on the activity contained in the PFR, DFR and MTR raffinate tanks. It has estimated that each cubic metre of waste will be contaminated by activity equivalent to that contained in 0.5 m<sup>3</sup> of raffinate. This is equivalent to a liquor film of 0.025 mm (or the dried out activity from the same film). This is probably pessimistic, though credible.

Other information: Specific activities have been re-evaluated since the 2016 UK Inventory. Arisings information is based on ADU Floc

**WASTE STREAM 5B314 HAL Store and Evaporation Plant ILW**

Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3			2.26E-05	CC 2	Gd 153			7.93E-14	CC 2
Be 10			2.95E-13	CC 2	Ho 163			8.78E-14	CC 2
C 14			2.42E-08	CC 2	Ho 166m			9.39E-12	CC 2
Na 22					Tm 170				
Al 26					Tm 171			5.38E-10	CC 2
Cl 36			6E-13	CC 2	Lu 174			1.32E-11	CC 2
Ar 39					Lu 176				
Ar 42					Hf 178n			9.27E-11	CC 2
K 40			4.43E-14	CC 2	Hf 182				
Ca 41			4.98E-11	CC 2	Pt 193			7.2E-10	CC 2
Mn 53			3.8E-13	CC 2	Tl 204			3.97E-08	CC 2
Mn 54	9.23E-12	CC 2	2.26E-08	CC 2	Pb 205			2.19E-14	CC 2
Fe 55			1.41E-05	CC 2	Pb 210	1.37E-11	CC 2	6.16E-15	CC 2
Co 60	6.25E-06	CC 2	2.01E-05	CC 2	Bi 208			1.63E-14	CC 2
Ni 59			8.96E-08	CC 2	Bi 210m				
Ni 63			4.32E-06	CC 2	Po 210	9.07E-12	CC 2		
Zn 65			2.05E-10	CC 2	Ra 223	8.14E-10	CC 2	1.88E-13	CC 2
Se 79			1.59E-07	CC 2	Ra 225	1.20E-14	CC 2	8.11E-15	CC 2
Kr 81					Ra 226	8.59E-11	CC 2	2.17E-14	CC 2
Kr 85					Ra 228	8.45E-10	CC 2		
Rb 87			5.55E-12	CC 2	Ac 227	8.23E-10	CC 2	1.91E-13	CC 2
Sr 90	8.05E-04	CC 2	1.26E-02	CC 2	Th 227	8.14E-10	CC 2	1.87E-13	CC 2
Zr 93			5.96E-06	CC 2	Th 228	1.85E-07	CC 2	4.03E-10	CC 2
Nb 91			1.37E-08	CC 2	Th 229	1.21E-14	CC 2	8.17E-15	CC 2
Nb 92			4.4E-13	CC 2	Th 230	2.73E-08	CC 2	8.11E-12	CC 2
Nb 93m			1.52E-05	CC 2	Th 232	1.21E-09	CC 2		
Nb 94			1.41E-07	CC 2	Th 234	4.46E-06	CC 2	5.58E-10	CC 2
Mo 93			5.24E-08	CC 2	Pa 231	3.24E-09	CC 2	6.95E-13	CC 2
Tc 97			8.54E-12	CC 2	Pa 233	2.69E-07	CC 2	3.52E-08	CC 2
Tc 99			1.25E-01	CC 2	U 232	1.80E-07	CC 2	7.71E-05	CC 2
Ru 106	2.55E-10	CC 2	1.34E-02	CC 2	U 233	1.51E-11	CC 2	1.34E-05	CC 2
Pd 107			2.74E-07	CC 2	U 234	2.27E-04	CC 2	1.2E-02	CC 2
Ag 108m			4.65E-10	CC 2	U 235	9.96E-06	CC 2	5.91E-05	CC 2
Ag 110m			6.46E-09	CC 2	U 236	1.16E-05	CC 2	1.25E-04	CC 2
Cd 109			1.21E-09	CC 2	U 238	4.46E-06	CC 2	1.54E-03	CC 2
Cd 113m			1.74E-06	CC 2	Np 237	2.7E-07	CC 2	2.47E-04	CC 2
Sn 119m			7.07E-10	CC 2	Pu 236			6.36E-08	CC 2
Sn 121m			2.51E-05	CC 2	Pu 238	1.40E-02	CC 2	2.39E+00	CC 2
Sn 123			4.35E-13	CC 2	Pu 239	1.67E-02	CC 2	1.55E-01	CC 2
Sn 126			5.49E-07	CC 2	Pu 240	2.48E-02	CC 2	1.57E-01	CC 2
Sb 125	1.45E-07	CC 2	3.85E-04	CC 2	Pu 241	4.39E-01	CC 2	3.65E+00	CC 2
Sb 126			7.68E-08	CC 2	Pu 242	2.22E-05	CC 2	1.25E-04	CC 2
Te 125m	3.54E-08	CC 2	9.33E-05	CC 2	Am 241	4.37E-02	CC 2	3.54E-02	CC 2
Te 127m					Am 242m	1.15E-06	CC 2	1.05E-04	CC 2
I 129			3.17E-04	CC 2	Am 243	1.57E-10	CC 2	6.4E-06	CC 2
Cs 134	2.62E-07	CC 2	1.56E-04	CC 2	Cm 242	9.59E-07	CC 2	1.07E-04	CC 2
Cs 135			7.68E-07	CC 2	Cm 243	9.12E-10	CC 2	2.61E-05	CC 2
Cs 137	1.09E-03	CC 2	3.62E-02	CC 2	Cm 244	9.45E-06	CC 2	2.82E-04	CC 2
Ba 133			8.54E-09	CC 2	Cm 245			1.73E-08	CC 2
La 137			5.55E-12	CC 2	Cm 246			6.83E-10	CC 2
La 138					Cm 248				
Ce 144			1.77E-05	CC 2	Cf 249			1.9E-14	CC 2
Pm 145			8.35E-11	CC 2	Cf 250			1.43E-14	CC 2
Pm 147	3.28E-06	CC 2	5.66E-03	CC 2	Cf 251				
Sm 147	1.85E-15	CC 2	3.97E-12	CC 2	Cf 252				
Sm 151	2.12E-05	CC 2	1.54E-03	CC 2	Other a				
Eu 152	2.90E-06	CC 2	1.9E-06	CC 2	Other b/g	1.06E-06	CC 2		
Eu 154	9.92E-06	CC 2	4.5E-02	CC 2	<b>Total a</b>	<b>9.94E-02</b>	<b>CC 2</b>	<b>2.75E+00</b>	<b>CC 2</b>
Eu 155	3.85E-06	CC 2	6.77E-02	CC 2	<b>Total b/g</b>	<b>4.41E-01</b>	<b>CC 2</b>	<b>3.96E+00</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