

<b>WASTE STREAM</b>	<b>5B335</b>	<b>Analytical Laboratories LLW</b>
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**SITE** Dounreay  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Dounreay Site Restoration Limited  
**WASTE TYPE** LLW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2022.....	971.0 m <sup>3</sup>
Total future arisings:		971.0 m <sup>3</sup>
Total waste volume:		971.0 m <sup>3</sup>

**Comment on volumes:** The laboratories will be decommissioned in two phases - the redundant laboratories will be decommissioned first, while the remaining labs will not be fully decommissioned until later. Arisings have been revised in line with Predictive Waste Inventory walk round exercise. It should be noted that the DSRL Site Programme is currently under review and any future arisings dates are subject to change. Stocks have been removed from this waste stream as these will be captured under 5B15 and 5B16.

**Uncertainty factors on volumes:**

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

**WASTE SOURCE** Laboratory decommissioning.

### PHYSICAL CHARACTERISTICS

**General description:** Plant structure materials, decontaminated items plus decommissioning process arisings. Items will be size reduced where practicable during decommissioning.

**Physical components (%wt):** Aluminium (0.20%), Asbestos (0.02%), Cementitious material (e.g. concrete) (0.20%), Copper (1.65%), Fibreglass (0.01%), Glass (1.78%), Iron (2.85%), Lead (1.20%), Mild Steel (87.46%), Other (0.09%), Other organics (0.13%), Paper (0.24%), Plastic (1.96%), Rubber (0.58%), Stainless steel (1.56%), Wood/ Wood composite (0.07%),

**Sealed sources:** Not yet determined.

**Bulk density (t/m<sup>3</sup>):** 0.64

**Comment on density:** The Bulk Density is based on consignor's records

### CHEMICAL COMPOSITION

**General description and components (%wt):** Aluminium (0.20%), Asbestos (0.02%), Cementitious material (e.g. concrete) (0.20%), Copper (1.65%), Fibreglass (0.01%), Glass (1.78%), Iron (2.85%), Lead (1.20%), Mild Steel (87.46%), Other (0.09%), Other organics (0.13%), Paper (0.24%), Plastic (1.96%), Rubber (0.58%), Stainless steel (1.56%), Wood/ Wood composite (0.07%),

**Chemical state:** Neutral

**Chemical form of radionuclides:**  
H-3: May be present at low levels.  
C-14: May be present at low levels.  
Cl-36: Not likely to be present  
Se-79: May be present at low levels.  
Tc-99: May be present at low levels.  
I-129: May be present at low levels.  
Ra: May be present at low levels.  
Th: May be present at low levels.  
U: Likely to be present at low levels, probably as oxide.  
Np: May be present at low levels.  
Pu: Likely to be present at low levels, probably as oxide.

**Metals and alloys (%wt):** Both bulk and sheet metals are likely to be present, proportions not specified.

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	Stainless steel.....	1.6	Assumed M316
	Other ferrous metals.....	87.5	Ferrous metals include stainless steels, though the proportions are unknown.
	Iron.....	2.9	
	Aluminium.....	0.20	
	Beryllium.....	NE	
	Cobalt.....		
	Copper.....	1.7	
	Lead.....	1.2	
	Magnox/Magnesium.....	NE	
	Nickel.....	NE	
	Titanium.....		
	Uranium.....	P	
	Zinc.....	NE	
	Zircaloy/Zirconium.....	NE	
	Other metals.....	0.09	
Organics (%wt):	PVC, hypalon and neoprene are likely to be present.		
	Total cellulosics.....	0.31	
	Paper, cotton.....	0.24	
	Wood.....	0.07	
	Halogenated plastics .....	0.98	
	Total non-halogenated plastics.....	0.98	
	Condensation polymers.....	NE	
	Others.....	0.98	
	Organic ion exchange materials....	0	
	Total rubber.....	0.58	
	Halogenated rubber .....	NE	
	Non-halogenated rubber.....	0.58	
	Hydrocarbons.....		
	Oil or grease .....		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	0.13	Fire Blanket Barrier
Other materials (%wt):	It is assumed that the asbestos content is mainly chrysotile with amosite board also present.		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	<0.20	

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Sand.....

Glass/Ceramics..... 1.8

Graphite..... 0

Desiccants/Catalysts.....

Asbestos..... 0.02

    Non/low friable.....

    Moderately friable.....

    Highly friable.....

Free aqueous liquids..... 0

Free non-aqueous liquids..... 0

Powder/Ash..... 0

## Inorganic anions (%wt):

Inorganic anions may be present at up to 3%.

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, acids and some hazardous chemicals may be present.

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.....

Pyrophoric materials.....

Generating toxic gases.....

Reacting with water.....

Active particles..... NE

Soluble solids as bulk chemical compounds..... NE

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Hazardous substances /  
non hazardous pollutants:

Lead is present as bricks. Lead is present at about 1.2%. Asbestos is also present.

Acrylamide.....	
Benzene.....	NE
Chlorinated solvents.....	
Formaldehyde.....	
Organometallics.....	
Phenol.....	NE
Styrene.....	
Tri-butyl phosphate.....	NE
Other organophosphates.....	
Vinyl chloride.....	NE
Arsenic.....	NE
Barium.....	
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.....	TR
EEE Type 2.....	TR
EEE Type 3.....	
EEE Type 4.....	
EEE Type 5.....	
Complexing agents (%wt):	Not yet determined
EDTA.....	
DPTA.....	
NTA.....	
Polycarboxylic acids.....	
Other organic complexants.....	NE
Total complexing agents.....	NE

Waste contains vacuum  
cleaners, lights, panels, alarms

Mass spectrometer, drying oven

Traces of decontamination  
reagents may be present.

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	9.4
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 is investigating the feasibility of alternative waste treatment routes but no decision has been made on their use yet.

**Disposal Routes:**

Disposal Route	Stream volume %
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	

**Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):**

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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			

**Waste Packaging for Disposal:**

Container	Stream volume %	Waste loading m <sup>3</sup>	Number of packages
1/3 Height IP-1 ISO	100.0	10	98
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:

The waste will consist of large uncompactable items and 200 litre drums that have already been compacted. DSRL is investigating the feasibility of alternative LLW Disposal Container.

**WASTE STREAM****5B335****Analytical Laboratories LLW****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: -

Potential for the waste to contain discrete items: -

**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: The radioactivity arises from contamination of laboratories.

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: By NDA and calculations.

Other information: Specific activity has been re-evaluated since 2016. The PWI gathers radiological information through averaging all historical consignments from the Labs. This is an alternate strategy to what may have been previously used in UKRWI.

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**Analytical Laboratories LLW**

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					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			1.50E-06	CC 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			1.51E-10	CC 2	Po 210		3.65E-12	CC 2	
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226		7.61E-12	CC 2	
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90			4.30E-06	CC 2	Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m			1.16E-08	CC 2	Th 232		1.29E-08	CC 2	
Nb 94			1.43E-09	CC 2	Th 234				
Mo 93			1.16E-08	CC 2	Pa 231				
Tc 97					Pa 233				
Tc 99			1.13E-10	CC 2	U 232				
Ru 106					U 233				
Pd 107					U 234		6.13E-07	CC 2	
Ag 108m					U 235		1.91E-08	CC 2	
Ag 110m					U 236		1.31E-08	CC 2	
Cd 109					U 238		1.02E-08	CC 2	
Cd 113m					Np 237		4.52E-09	CC 2	
Sn 119m					Pu 236				
Sn 121m			1.13E-10	CC 2	Pu 238		8.32E-07	CC 2	
Sn 123					Pu 239		1.03E-06	CC 2	
Sn 126					Pu 240		3.07E-07	CC 2	
Sb 125					Pu 241		1.55E-05	CC 2	
Sb 126					Pu 242				
Te 125m					Am 241		2.64E-06	CC 2	
Te 127m					Am 242m				
I 129					Am 243		1.13E-12	CC 2	
Cs 134			7.51E-09	CC 2	Cm 242		3.06E-09	CC 2	
Cs 135					Cm 243		1.34E-10	CC 2	
Cs 137			1.14E-05	CC 2	Cm 244		1.13E-07	CC 2	
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147			1.45E-06	CC 2	Cf 251				
Sm 147					Cf 252				
Sm 151			2.29E-09	CC 2	Other a				
Eu 152			1.38E-07	CC 2	Other b/g				
Eu 154			3.62E-08	CC 2	<b>Total a</b>	<b>0</b>	<b>5.59E-06</b>	<b>CC 2</b>	
Eu 155			3.78E-11	CC 2	<b>Total b/g</b>	<b>0</b>	<b>3.44E-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