

**WASTE STREAM****5B365/C Decommissioning LLW Conditioned Bulk**

**SITE** Dounreay  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Dounreay Site Restoration Limited

**WASTE TYPE** LLW

**WASTE VOLUMES**

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	529.0 m <sup>3</sup>	663.0 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>	0 m <sup>3</sup>
Total waste volume:		529.0 m <sup>3</sup>	663.0 m <sup>3</sup>

**Comment on volumes:** Arisings will originate from all unconditioned LLW streams. Arisings based the ratio of HHISOs already grouted containing only bulk items. Approximate arisings volume = 9461m<sup>3</sup>. There will be high uncertainty in this number as how a HHISO is packaged will be based on the available waste types on the day. Stocks value is expected to rise as more waste is conditioned. The waste has already been generated and each item has a declared waste volume. This waste stream comprises of 34 conditioned HHISOs containing LLW bulk wastes only.

**Uncertainty factors on volumes:** Stock (upper): x 1.02 Arisings (upper) x  
 Stock (lower): x 0.98 Arisings (lower) x

**WASTE SOURCE** All wastes that have been listed in an unconditioned LLW UKRWI waste stream will be conditioned and added to this waste stream. This includes decommissioning of reactor facilities, reprocessing facilities, and facilities with support functions.

**PHYSICAL CHARACTERISTICS**

**General description:** LLW Bulk wastes only. This consists of: gloveboxes, ducting, and other redundant bulk wastes that cannot be size reduced into 200 l drums. This waste has been packaged into disposal containers and encapsulated with grout.

**Physical components (%wt):** Large plant items such as: tanks, pipework, shield blocks, roof plates, concrete structures, ventilation ducting, etc. not able to be size reduced into a 200L drum. Includes cemented sludge drums from effluent treatment plant.

**Sealed sources:** The waste contains sealed sources. Redundant LLW sources from Labs, Uranium Recovery Plant, Pu Fuels exam facility, WRACS, DFR, PFR

**Bulk density (t/m<sup>3</sup>):** 2.42

**Comment on density:** Average the final mass of each conditioned HHISO/15.56m<sup>3</sup> /1000

**CHEMICAL COMPOSITION**

**General description and components (%wt):** Steel (76.6%), Lead (4.14%), Aluminium (0.39%), Copper (1.68%), Glass (0.12%), Rubber (0.37%), Wood (1.51%), Paper (0.35%), Non-halogenated (0.63%), Halogenated Plastic (0.7%), Ceramic (0.00%), Rubble (4.02%), Concrete (2.62%), Soil (0.00%), Cemented Sludge (0.05%) and Others (6.82%).

**Chemical state:** Neutral

**Chemical form of radionuclides:** H-3: Possibly present.  
 C-14: Possibly present.  
 Cl-36: Possibly present.  
 Se-79: Possibly present.  
 Tc-99: Possibly present.  
 I-129: Possibly present.  
 Ra: Not known to be present.  
 Th: Present in the form of contamination.  
 U: Present in the form of contamination.  
 Np: Possibly present.  
 Pu: Possibly present in the form of contamination.

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

**WASTE STREAM**

**5B365/C Decommissioning LLW Conditioned Bulk**

	Stainless steel.....		
	Other ferrous metals.....	76.6	
	Iron.....		
	Aluminium.....	0.39	
	Beryllium.....	NE	
	Cobalt.....		
	Copper.....	1.7	
	Lead.....	4.1	
	Magnox/Magnesium.....	NE	
	Nickel.....		
	Titanium.....		
	Uranium.....	P	
	Zinc.....	NE	
	Zircaloy/Zirconium.....	NE	
	Other metals.....	6.8	
Organics (%wt):	-		
	Total cellulose.....	1.9	
	Paper, cotton.....	0.35	
	Wood.....	1.5	
	Halogenated plastics .....	0.70	
	Total non-halogenated plastics.....	0.63	
	Condensation polymers.....	TR	
	Others.....		
	Organic ion exchange materials....		
	Total rubber.....	0.37	
	Halogenated rubber .....	NE	
	Non-halogenated rubber.....		
	Hydrocarbons.....		
	Oil or grease .....		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	TR	
Other materials (%wt):	-		
	Inorganic ion exchange materials.		
	Inorganic sludges and flocs.....		
	Soil.....	0	
	Brick/Stone/Rubble.....	4.0	
	Cementitious material.....	2.7	Concrete + Cmented Sludge
	Sand.....		
	Glass/Ceramics.....	0.12	

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	Graphite.....	
	Desiccants/Catalysts.....	
	Asbestos.....	TR
	Non/low friable.....	TR
	Moderately friable.....	TR
	Highly friable.....	TR
	Free aqueous liquids.....	
	Free non-aqueous liquids.....	
	Powder/Ash.....	
Inorganic anions (%wt):	-	
	Fluoride.....	NE
	Chloride.....	NE
	Iodide.....	NE
	Cyanide.....	NE
	Carbonate.....	NE
	Nitrate.....	TR
	Nitrite.....	NE
	Phosphate.....	TR
	Sulphate.....	NE
	Sulphide.....	NE
Materials of interest for waste acceptance criteria:	-	
	Combustible metals.....	0
	Low flash point liquids.....	0
	Explosive materials.....	0
	Phosphorus.....	0
	Hydrides.....	0
	Biological etc. materials.....	0
	Biodegradable materials.....	
	Putrescible wastes.....	
	Non-putrescible wastes.....	
	Corrosive materials.....	
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	0
	Active particles.....	
	Soluble solids as bulk chemical compounds.....	
Hazardous substances / non hazardous pollutants:	-	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	

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Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

Boron.....

Cadmium.....

Caesium.....

Selenium.....

Chromium.....

Molybdenum.....

Thallium.....

Tin.....

Vanadium.....

Mercury compounds.....

Others.....

Electronic Electrical Equipment (EEE)

EEE Type 1..... TR

a few references to hoovers,  
power tools etc. within  
consignment descriptions

EEE Type 2.....

EEE Type 3..... TR

a few references to hoovers,  
power tools etc. within  
consignment descriptions

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt):

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Total complexing agents.....

**TREATMENT, PACKAGING AND DISPOSAL**

**WASTE STREAM****5B365/C Decommissioning LLW Conditioned Bulk**

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	On-site	100.0

Comment on planned treatments:

All waste has been encapsulated within HHISOs and has been either disposed at the LLW Vaults or is in temporary storage awaiting final disposal.

**Disposal Routes:**

Disposal Route	Stream volume %
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

**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 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	15.56	34

Other information:

DSRL is investigating the feasibility of alternative LLW Disposal Container.

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

Container voidage: -

Waste Characterisation Form (WCH): -

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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: A mixture of fission products, actinides and activation products.

Uncertainty: Activity is based on consignor's records.

Definition of total alpha and total beta/gamma: Total alpha and beta/gamma are derived from consignor's records for the waste stored in the containers.

Measurement of radioactivities: The specific activities have been measured or derived by a variety of methods which are outlined in the PSWPs. Arisings is a copy of the stocks. A more detailed breakdown of arising activities can be found in the individual LLW UKRWI datasheets.

Other information: There are no unlisted radionuclides present at significant concentrations.

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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	1.67E-06	BB 2			Gd 153				
Be 10					Ho 163				
C 14	9.01E-08	BB 2			Ho 166m				
Na 22	5.1E-09	BB 2			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	4.73E-14	BB 2			Pb 205				
Fe 55	4.21E-10	BB 2			Pb 210				
Co 60	2.24E-07	BB 2			Bi 208				
Ni 59	1.50E-13	BB 2			Bi 210m				
Ni 63	9.32E-09	BB 2			Po 210	6.11E-13	BB 2		
Zn 65	1.78E-18	BB 2			Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	2.75E-12	BB 2		
Kr 85					Ra 228	1.45E-10	BB 2		
Rb 87					Ac 227				
Sr 90	1.61E-06	BB 2			Th 227				
Zr 93					Th 228	2.52E-09	BB 2		
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m	1.13E-08	BB 2			Th 232	2.17E-10	BB 2		
Nb 94	2.63E-11	BB 2			Th 234				
Mo 93	1.13E-08	BB 2			Pa 231				
Tc 97					Pa 233				
Tc 99	1.12E-10	BB 2			U 232	2.44E-09	BB 2		
Ru 106	4.68E-12	BB 2			U 233				
Pd 107					U 234	1.04E-06	BB 2		
Ag 108m	5.65E-11	BB 2			U 235	2.17E-08	BB 2		
Ag 110m					U 236	1.29E-07	BB 2		
Cd 109	6.81E-12	BB 2			U 238	5.85E-09	BB 2		
Cd 113m					Np 237	7.81E-13	BB 2		
Sn 119m					Pu 236				
Sn 121m	8.26E-11	BB 2			Pu 238	1.05E-07	BB 2		
Sn 123					Pu 239	1.35E-07	BB 2		
Sn 126					Pu 240	7.11E-08	BB 2		
Sb 125	1.09E-09	BB 2			Pu 241	5.63E-07	BB 2		
Sb 126					Pu 242	1.14E-10	BB 2		
Te 125m					Am 241	1E-07	BB 2		
Te 127m					Am 242m	9.22E-10	BB 2		
I 129					Am 243	1.66E-11	BB 2		
Cs 134	4.04E-10	BB 2			Cm 242	7.70E-10	BB 2		
Cs 135					Cm 243	9.78E-11	BB 2		
Cs 137	3.07E-06	BB 2			Cm 244	2.52E-09	BB 2		
Ba 133	4.64E-10	BB 2			Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	4.85E-13	BB 2			Cf 249				
Pm 145					Cf 250				
Pm 147	9.27E-09	BB 2			Cf 251				
Sm 147					Cf 252				
Sm 151	2.46E-08	BB 2			Other a				
Eu 152	8.25E-08	BB 2			Other b/g	1.64E-11	BB 2		
Eu 154	9.08E-08	BB 2			<b>Total a</b>	<b>1.62E-06</b>	<b>BB 2</b>		<b>0</b>
Eu 155	4.04E-09	BB 2			<b>Total b/g</b>	<b>7.47E-06</b>	<b>BB 2</b>		<b>0</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