

WASTE STREAM	5B15	Compacted LLW
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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.....	9232.7 m ³
Total future arisings:		0 m ³
Total waste volume:		9232.7 m ³

Comment on volumes: This waste stream captures all LLW which is packaged into drums, supercompacted and then loaded into containers for storage awaiting disposal. Future arisings are not reported to avoid double counting, as future arisings are captured within the waste streams from which the waste originates before being compacted. These waste streams are: 5B301, 5B303, 5B305, 5B307, 5B309, 5B311, 5B313, 5B315, 5B329, 5B331, 5B333, 5B335, 5B337, 5B339, 5B341, 5B343, 5B345, 5B348, 5B349, 5B351, 5B352, and 5B358. Stocks are stored onsite in HHISOs. They comprise of compacted and uncompact drums. All drums assigned 0.2m³ volume.

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

WASTE SOURCE Waste from analytical laboratories, reactor and reprocessing plant.

PHYSICAL CHARACTERISTICS

General description: General and soft trash, including intractable organics, glassware and metal waste. Trace quantities of laboratory chemicals may be present. Waste is placed in metal drums which are supercompacted. The waste contains no large items. The majority of waste is within 60165 supercompacted drums. This leaves 899 drums in stocks and 302 drums in WRACS requiring supercompaction.

Physical components (%vol): Glassware in fibre bins, small tools, plant and rig equipment, swabs, rubber gloves, plastic clothing and boots etc.

Sealed sources: Not yet determined.

Bulk density (t/m³): 0.31

Comment on density: Based on consignors records for consigned drums.

CHEMICAL COMPOSITION

General description and components (%wt): Steel (47.45%), aluminium (0.89%), copper (1.85%), lead (1.59%), paper (7.63%), wood (4.06%), halogenated plastics (2.77%), non halogenated plastics (8.00%), rubber (4.66%), soil (0.16%), rubble (3.68%), concrete (5.08%), glass (0.38%), ceramics (0.05%), cemented sludge (3.13%), others (8.61%).

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): The metals are supercompacted, and include the mild steel drums themselves.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	47.5		
Iron.....			
Aluminium.....	0.89		
Beryllium.....	NE		
Cobalt.....	0		
Copper.....	1.9		
Lead.....	1.6		
Magnox/Magnesium.....	NE		
Nickel.....			
Titanium.....			
Uranium.....	P		
Zinc.....	NE		
Zircaloy/Zirconium.....	NE		
Other metals.....	8.6	Traces of other, unspecified, metals will be present.	

Organics (%wt):

Halogenated plastic is present as PVC, non-halogenated plastic as polythene.
 Halogenated plastic is present as PVC, halogenated rubber likely to be present as neoprene.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	11.7		
Paper, cotton.....	7.6		
Wood.....	4.1		
Halogenated plastics	2.8		
Total non-halogenated plastics.....	8.0		
Condensation polymers.....	TR		
Others.....	8.0		
Organic ion exchange materials....	0		
Total rubber.....	4.7		
Halogenated rubber	NE		
Non-halogenated rubber.....	4.7		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	TR		

Other materials (%wt): -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0.16		
Brick/Stone/Rubble.....	3.7		
Cementitious material.....	8.2	Cementitious material + cemented sludge	
Sand.....			
Glass/Ceramics.....	0.43		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	TR		
Non/low friable.....	TR		
Moderately friable.....	TR		
Highly friable.....	TR		
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): Inorganic anions may be found in the waste, but only in trace quantities.

	(%wt)	Type(s) and comment
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: Asbestos arises from refurbishment of old facilities. Putrescible waste may be present in small quantities but is not a hazard. Nitric acid may be present on swabs.

	(%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.....		
Putrescible wastes.....		
Non-putrescible wastes.....		

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Corrosive materials.....
 Pyrophoric materials..... 0
 Generating toxic gases..... 0
 Reacting with water..... 0
 Higher activity particles.....
 Soluble solids as bulk chemical
 compounds.....

Hazardous substances / non hazardous pollutants: Lead (1.59%) and asbestos is present in the waste. Trace amounts of cadmium are also likely.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....		
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....		
Caesium.....		
Selenium.....		
Chromium.....		
Molybdenum.....		
Thallium.....		
Tin.....		
Vanadium.....		
Mercury compounds.....		
Others.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	TR	
EEE Type 2.....		
EEE Type 3.....	TR	
EEE Type 4.....		
EEE Type 5.....		

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		Trace amounts of complexing agents, including DECON 90, may be present.
Total complexing agents.....	TR	

Potential for the waste to contain discrete items: Yes. Engineered steel structures, uncompacted drums

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):	Treatment	On-site / Off site	Stream volume %
	Low force compaction	On-site	0.90
	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. No further treatment will be carried out while the waste remains in storage. The waste will be encapsulated before final disposal.

Disposal Routes:	Disposal Route	Stream volume %	Disposal density t/m3
	Expected to be consigned to the LLW Repository	100.0	1.8
	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):

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			

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Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at a Near Surface / Near Site Disposal Facility	Incineration	<100.0	TBD	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. This route is potentially suitable for all compactable wastes

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m ³	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	50	185

Other information: The majority of waste consists of 200 litre drums that have already been compacted. No further compaction is possible. The remains of the waste are drums awaiting compaction which are in temporary storage. All drums, once compacted will go into HHISO containers, mixed with bulk LLW wastes, prior to encapsulation and final disposal. A general assumption is 250 drums per HHISO (as pucks). Each drum - precompact - is 0.2m³. 250*0.2 = 50m³ Loading. Volume in Datasheet is precompact volume.

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: 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 using consignment data. Consignment data was collated and summed together, then divided by the total volume of

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Other information:

consignments. A decay was applied to the average consignment date of the consignments.
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	7.17E-06	BB 2			Gd 153				
Be 10					Ho 163				
C 14	2.43E-06	BB 2			Ho 166m	1.44E-14	BB 2		
Na 22	7.51E-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	1.36E-13	BB 2			Pb 205				
Fe 55	3.18E-10	BB 2			Pb 210				
Co 60	7.70E-07	BB 2			Bi 208				
Ni 59	1.28E-13	BB 2			Bi 210m				
Ni 63	3.11E-08	BB 2			Po 210	4.39E-07	BB 2		
Zn 65	8.11E-17	BB 2			Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	6.02E-06	BB 2		
Kr 85	1.78E-13	BB 2			Ra 228	2.02E-10	BB 2		
Rb 87					Ac 227				
Sr 90	4.38E-06	BB 2			Th 227				
Zr 93					Th 228	9.6E-09	BB 2		
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m	1.40E-08	BB 2			Th 232	2.25E-10	BB 2		
Nb 94	2.77E-10	BB 2			Th 234	2.07E-08	BB 2		
Mo 93	1.43E-08	BB 2			Pa 231				
Tc 97					Pa 233				
Tc 99	2.75E-10	BB 2			U 232	9.55E-09	BB 2		
Ru 106	2.56E-11	BB 2			U 233	2.03E-13	BB 2		
Pd 107					U 234	3.47E-06	BB 2		
Ag 108m	1.21E-10	BB 2			U 235	1.04E-07	BB 2		
Ag 110m					U 236	3.31E-07	BB 2		
Cd 109	3.03E-11	BB 2			U 238	2.07E-08	BB 2		
Cd 113m	2.32E-15	BB 2			Np 237	4.67E-11	BB 2		
Sn 119m					Pu 236				
Sn 121m	1.06E-10	BB 2			Pu 238	3.00E-06	BB 2		
Sn 123					Pu 239	2.84E-06	BB 2		
Sn 126					Pu 240	4.14E-06	BB 2		
Sb 125	2.97E-09	BB 2			Pu 241	9.79E-06	BB 2		
Sb 126					Pu 242	3.41E-10	BB 2		
Te 125m	7.44E-10	BB 2			Am 241	5.37E-06	BB 2		
Te 127m					Am 242m	1.50E-08	BB 2		
I 129					Am 243	1.57E-10	BB 2		
Cs 134	3.66E-09	BB 2			Cm 242	1.24E-08	BB 2		
Cs 135					Cm 243	9.49E-10	BB 2		
Cs 137	9.58E-06	BB 2			Cm 244	6.04E-08	BB 2		
Ba 133	2.38E-09	BB 2			Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	2.84E-13	BB 2			Cf 249				
Pm 145					Cf 250				
Pm 147	7.46E-08	BB 2			Cf 251				
Sm 147					Cf 252				
Sm 151	1.65E-07	BB 2			Other a	6.04E-06	BB 2		
Eu 152	1.93E-07	BB 2			Other b/g	1.92E-05	BB 2		
Eu 154	2.08E-07	BB 2			Total a	3.19E-05	BB 2		0
Eu 155	3.53E-08	BB 2			Total b/g	5.42E-05	BB 2		0

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