

WASTE STREAM	5B303	Dounreay Fast Reactor LLW
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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 ³
Future arisings -	1.4.2019 - 31.3.2028.....	2879.0 m ³
Total future arisings:		2879.0 m ³
Total waste volume:		2879.0 m ³

Comment on volumes: Waste arisings have been updated in line with Predictive Waste Inventory. Stocks will be captured in waste streams 5B15 and 5B16. It should be noted that DSRL site programme is currently under review and future arisings dates are subject to change.

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

WASTE SOURCE Reactor decommissioning.

PHYSICAL CHARACTERISTICS

General description: Plant, equipment, pipework, ducting and structures from a demonstration fast reactor. Items will be size reduced where practicable during decommissioning.

Physical components (%vol): Aluminium (0.03%), Asbestos (5.43%), Asphalt (1.40%), Cementitious material (e.g. concrete) (29.24%), Copper (3.01%), Fibreglass (4.50%), Glass (0.26%), Graphite (0.02%), Gypsum Plasterboard/ Fibreboard (0.02%), Lead (2.76%), Mild Steel (35.74%), Other (3.82%), Paper (1.81%), Plastic (2.86%), Rubber (0.76%), Stainless steel (8.03%), WEEE not containing hazardous components (0.05%), Wood/ Wood composite (0.25%),

Sealed sources: Not yet determined.

Bulk density (t/m³): 0.56

Comment on density: The bulk density is based off consignor's records.

CHEMICAL COMPOSITION

General description and components (%wt): Aluminium (0.03%), Asbestos (5.43%), Asphalt (1.40%), Cementitious material (e.g. concrete) (29.24%), Copper (3.01%), Fibreglass (4.50%), Glass (0.26%), Graphite (0.02%), Gypsum Plasterboard/ Fibreboard (0.02%), Lead (2.76%), Mild Steel (35.74%), Other (3.82%), Paper (1.81%), Plastic (2.86%), Rubber (0.76%), Stainless steel (8.03%), WEEE not containing hazardous components (0.05%), Wood/ Wood composite (0.25%),

Chemical state: Neutral

Chemical form of radionuclides: Cl-36: Not known to be present.
 I-129: Not known to be present.
 U: Possibly present as contamination.
 Np: Possibly present at extremely low levels.
 Pu: Possibly present at extremely low levels.

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

Stainless steel.....	8.0
Other ferrous metals.....	35.7
Iron.....	
Aluminium.....	TR
Beryllium.....	
Cobalt.....	NE
Copper.....	3.0
Lead.....	2.8
Magnox/Magnesium.....	NE

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	Nickel.....	NE	
	Titanium.....		
	Uranium.....		
	Zinc.....	NE	
	Zircaloy/Zirconium.....	NE	
	Other metals.....	3.9	Others (4.2%) are alloys of unknown composition.
Organics (%wt):	The waste contains halogenated and non-halogenated plastics and rubber. Wood may be present but only in small amounts. PVC and neoprene are likely to be present.		
	Total cellulosics.....	2.1	
	Paper, cotton.....	1.8	
	Wood.....	0.25	
	Halogenated plastics	3.7	PVC
	Total non-halogenated plastics.....	3.7	
	Condensation polymers.....	TR	
	Others.....	<1.4	
	Organic ion exchange materials....	0	
	Total rubber.....	0.76	
	Halogenated rubber	0.38	Neoprene
	Non-halogenated rubber.....	0.38	
	Hydrocarbons.....	1.4	
	Oil or grease		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...	0.70	
	Asphalt/Tarmac (no coal tar)....	0.70	
	Bitumen.....		
	Others.....		
	Other organics.....		
Other materials (%wt):	Fibreglass 4.5%, Plasterboard 0.02%, WEEE 0.05%		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....		
	Brick/Stone/Rubble.....		
	Cementitious material.....	29.2	
	Sand.....		
	Glass/Ceramics.....	0.26	
	Graphite.....	P	
	Desiccants/Catalysts.....		
	Asbestos.....	5.4	Type unknown at present - not accessible
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	0	

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	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	Inorganic anions are present at approximately 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 is present. NaK contamination may also 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.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	
	Active particles.....	NE
	Soluble solids as bulk chemical compounds.....	0
Hazardous substances / non hazardous pollutants:	Lead and asbestos are present.	
	Acrylamide.....	
	Benzene.....	NE
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	NE
	Styrene.....	
	Tri-butyl phosphate.....	NE
	Other organophosphates.....	
	Vinyl chloride.....	NE

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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..... ~0.05
 EEE Type 2.....
 EEE Type 3.....
 EEE Type 4.....
 EEE Type 5.....

Control panels, lights, junction boxes

Complexing agents (%wt):

No
 EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	25.0
Supercompaction (HFC)		
Incineration	On-site	100.0
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various	75.0	
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.

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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 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	10	288

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 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: -

WASTE STREAM**5B303****Dounreay Fast Reactor LLW****RADIOACTIVITY**

Source:	The radioactivity arises from contamination of reactor building construction materials.
Uncertainty:	Within a factor of 10.
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:	Mainly from NDA measurements and consignor's records.
Other information:	Specific activity has been reevaluated since 2016.

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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			1.44E-09	CC 2	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			8.59E-15	CC 2	Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55			7.21E-15	CC 2	Pb 210				
Co 60			1.50E-10	CC 2	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			5.56E-07	CC 2	Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232		9.43E-16	CC 2	
Nb 94			4.78E-10	CC 2	Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235		9.43E-17	CC 2	
Ag 110m					U 236		8.49E-17	CC 2	
Cd 109					U 238		3.51E-14	CC 2	
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238		4.44E-10	CC 2	
Sn 123					Pu 239		1.67E-09	CC 2	
Sn 126					Pu 240		1.36E-09	CC 2	
Sb 125					Pu 241		1.43E-09	CC 2	
Sb 126					Pu 242		2.99E-12	CC 2	
Te 125m					Am 241		3.99E-10	CC 2	
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137			2.16E-06	CC 2	Cm 244				
Ba 133			7.98E-14	CC 2	Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144			2.83E-17	CC 2	Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152			2.21E-14	CC 2	Other b/g		8.49E-17	CC 2	
Eu 154					Total a	0	3.87E-09	CC 2	
Eu 155					Total b/g	0	2.71E-06	CC 2	

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