WASTE STREAM 5B16 Bulk Operational LLW

SITE	Dounreay
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Dounreay Site Restoration Limited
WASTE TYPE	LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	2877.8 m³
Total future arisings:		0 m³
Total waste volume:		2877.8 m³

Comment on volumes: This waste stream captures all Bulk LLW which is packaged 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. 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. The increase in stock in this waste stream since 2016 relates to the generation and consignment of bulk waste which have been packaged with other waste stream waste into containers for storage awaiting encapsulation and disposal. Previous estimates have been based on container numbers and internal /external container volumes. This estimate is based on individual package data. Some uncertainty will arise as this waste stream contains historical waste packages with outdated / incomplete waste records.

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

WASTE SOURCE Large items of waste from reactor and reprocessing operations and support facilities.

PHYSICAL CHARACTERISTICS

General description: Gloveboxes, ducting and other redundant bulk wastes that cannot be size reduced into 200 l drums. The waste has been packaged into disposal containers.

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: Not yet determined.

Bulk density (t/m³): 1.2

Comment on density: Based on consignor's records

CHEMICAL COMPOSITION

General description and components (%wt): Steel (66.8%), Lead (6.98%), Aluminium (0.04%), Copper (0.19%), Glass (0.11%), Rubber (0.15%), Wood (2.16%), Paper (0.18%), Unhalogenated plastic (0.79%), halogenated plastic (0.4%), Ceramics (0.01%), Rubble (3.53%), Concrete(14.71%), Soil (0.2%), Cemented Sludge (1.15%), and other materials (2.6%).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: tritiated steel is present.
C-14: May be present at low concentrations.
Cl-36: May be present at low concentrations.
Tc-99: May be present at low concentrations.
I-129: May be present at low concentrations.
Ra: May be present at low concentrations.
Th: May be present at low concentrations.
U: Likely to be present as oxide, nitrate or metal.
Np: May be present at low concentrations.
Pu: Likely to be present as oxide, nitrate or metal.

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

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	Stainless steel	0	
	Other ferrous metals	66.8	
	Iron		
	Aluminium	0.04	
	Beryllium		
	Cobalt	0	
	Copper	0.19	
	Lead	7.0	
	Magnox/Magnesium	0	
	Nickel		
	Titanium		
	Uranium		
	Zinc	TR	
	Zircaloy/Zirconium	0	
	Other metals	2.6	Trace quantities of other, unspecified, metals may be present.
Organics (%wt):	The waste is wrapped in polythene. PVC may be present.		
	Total cellulosics	2.3	
	Paper, cotton	0.18	
	Wood	2.2	
	Halogenated plastics	0.40	
	Total non-halogenated plastics	0.79	
	Condensation polymers	NE	
	Others		
	Organic ion exchange materials	0	
	Total rubber	0.15	
	Halogenated rubber	TR	
	Non-halogenated rubber	TR	
	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	0	
	Soil	0.20	
	Brick/Stone/Rubble	3.5	
	Cementitious material	15.9	Concrete + Cemented sludge

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	Sand	0
	Glass/Ceramics	0.12
	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):	Trace quantities only.	
	Fluoride	TR
	Chloride	TR
	Iodide	0
	Cyanide	TR
	Carbonate	TR
	Nitrate	TR
	Nitrite	TR
	Phosphate	TR
	Sulphate	TR
	Sulphide	TR
Materials of interest for waste acceptance criteria:	Items are treated before consignment and/or potential future disposal to ensure that no fire or non-radiological hazard is 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	0
	Active particles	
	Soluble solids as bulk chemical compounds	

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Hazardous substances / non hazardous pollutants: Lead will be present, mostly in the form of bricks.

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	
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

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TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		
Solidification	On-site	72.5
Decontamination		
Metal treatment	Off-site	27.5
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		

Comment on planned treatments: Bulk wastes in HHISO containers will be encapsulated at the grout plant prior to emplacement within the LLW Vault. HHISOs containing tritiated steel and other items of suitable bulk waste may undergo treatment and disposal offsite.

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	72.5
Expected to be consigned to an Incineration Facility	
Expected to be consigned to a Metal Treatment Facility	27.5
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^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	94.4	10	272
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: This waste consists of large items non-compactable waste. DSRL are developing a non-IP2 HHISO for use specifically at Dounreay. A small % of waste is non-containerised and will go for direct disposal in vaults.

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

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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:

Stream volume (%):	0.01
Waste stream variation:	There is no existing waste stream variation for this waste
Bounding cuboidal volume:	132.0
Inaccessible voidage:	TBC
Other information:	Some Non-containerised waste will be assessed for direct disposal in the Dounreay Vaults

RADIOACTIVITY

Source:	This waste originates from a wide variety of activities on site including reactor operations, fuel reprocessing and general site activities. It will therefore contain a mixture of fission products and activation products.
Uncertainty:	Within a factor of three.
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 specific activities have been derived from using the summation of consignor's declarations divided by the total declared volume. Some records have been omitted due to being erroneous. Stocks decayed based on the period starting on the average date when waste was consigned.
Other information:	There are no unlisted radionuclides present at significant concentrations.

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	4.29E-04	B B 2			Gd 153				
Be 10					Ho 163				
C 14	1.11E-06	B B 2			Ho 166m				
Na 22	1.95E-08	B B 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	3.30E-11	B B 2			Pb 205				
Fe 55	1.54E-09	B B 2			Pb 210				
Co 60	8.39E-07	B B 2			Bi 208				
Ni 59					Bi 210m				
Ni 63	1.10E-08	B B 2			Po 210	3.94E-13	B B 2		
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	2.91E-12	B B 2		
Kr 85					Ra 228	4.65E-10	B B 2		
Rb 87					Ac 227				
Sr 90	1.13E-05	B B 2			Th 227				
Zr 93					Th 228	3.60E-09	B B 2		
Nb 91					Th 229				
Nb 92					Th 230	8.43E-10	B B 2		
Nb 93m	6.98E-09	B B 2			Th 232	5.77E-10	B B 2		
Nb 94	3.27E-09	B B 2			Th 234	8.31E-08	B B 2		
Mo 93	6.97E-09	B B 2			Pa 231				
Tc 97					Pa 233				
Tc 99	5.97E-11	B B 2			U 232	3.28E-09	B B 2		
Ru 106	2.06E-10	B B 2			U 233	8.45E-15	B B 2		
Pd 107					U 234	1.15E-05	B B 2		
Ag 108m					U 235	3.35E-07	B B 2		
Ag 110m					U 236	8.06E-07	B B 2		
Cd 109	9.21E-12	B B 2			U 238	8.31E-08	B B 2		
Cd 113m					Np 237	3.81E-12	B B 2		
Sn 119m					Pu 236				
Sn 121m	5.12E-11	B B 2			Pu 238	6.11E-07	B B 2		
Sn 123					Pu 239	9.97E-07	B B 2		
Sn 126					Pu 240	8.01E-07	B B 2		
Sb 125	1.43E-08	B B 2			Pu 241	1.84E-05	B B 2		
Sb 126					Pu 242	6.12E-10	B B 2		
Te 125m					Am 241	1.57E-06	B B 2		
Te 127m					Am 242m	2.37E-08	B B 2		
I 129					Am 243	2.63E-13	B B 2		
Cs 134	1.53E-08	B B 2			Cm 242	1.98E-08	B B 2		
Cs 135					Cm 243	4.32E-09	B B 2		
Cs 137	4.16E-05	B B 2			Cm 244	6.22E-08	B B 2		
Ba 133	1.22E-09	B B 2			Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	1.25E-14	B B 2			Cf 249				
Pm 145					Cf 250				
Pm 147	3.22E-07	B B 2			Cf 251				
Sm 147					Cf 252				
Sm 151	3.96E-07	B B 2			Other a				
Eu 152	6.53E-07	B B 2			Other b/g	8.41E-11	B B 2		
Eu 154	5.50E-07	B B 2			**Total a**	**1.68E-05**	**B B 2**	**0**	
Eu 155	7.12E-08	B B 2			**Total b/g**	**5.04E-04**	**B B 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