WASTE STREAM 5B304 Dounreay Fast Reactor ILW

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

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2019 - 31.3.2028.....	256.0 m³
Total future arisings:		256.0 m³
Total waste volume:		256.0 m³

Comment on volumes: It should be noted that the DSRL site programme is under review and that arisings dates are subject to change. Arisings volumes have been amended in line with Predictive Waste Inventory walkdown exercise.

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: The waste will include reactor components, mainly irradiated steels, graphite, pipework which has been NaK cleaned and fuel cladding. Some items may be size reduced during decommissioning operations. There may be items of a large or heavy nature requiring special consideration.

Physical components (%vol): Fuel handling equipment and reactor steelwork (78%), shielding (22%).

Sealed sources: Not yet determined.

Bulk density (t/m³): 1.44

Comment on density: The bulk density is based on Consignor's records

CHEMICAL COMPOSITION

General description and components (%wt): Copper (0.10%), Graphite (22.06%), Lead (0.11%), Mild Steel (0.05%), Nickel (0.25%), Plastic (0.02%), Stainless steel (77.40%),

Chemical state: Neutral

Chemical form of radionuclides:
H-3: May be present in tritiated steel.
C-14: Not expected to be present.
Cl-36: Likely to be present
I-129: Likely to be present
Ra: Not expected to be present.
Th: Not expected to be present.
U: Expected to be present at low levels as oxide.
Pu: Expected to be present at extremely low levels as oxide.

Metals and alloys (%wt): -

Stainless steel.....	77.4	assumed to be 316L.
Other ferrous metals.....	0.06	mild steel
Iron.....		
Aluminium.....		
Beryllium.....		
Cobalt.....		
Copper.....	0.10	
Lead.....	0.11	
Magnox/Magnesium.....		
Nickel.....	0.25	

	Titanium		
	Uranium		
	Zinc	0	
	Zircaloy/Zirconium		
	Other metals	NE	Trace quantities of sodium and potassium.
Organics (%wt):	Cellulose may be present but only in trace quantities.		
	Total cellulosics	TR	
	Paper, cotton	TR	
	Wood	TR	
	Halogenated plastics	TR	
	Total non-halogenated plastics	0.02	
	Condensation polymers	NE	
	Others	NE	
	Organic ion exchange materials	0	
	Total rubber	TR	
	Halogenated rubber	NE	
	Non-halogenated rubber	NE	
	Hydrocarbons		
	Oil or grease		
	Fuel		
	Asphalt/Tarmac (cont.coal tar)		
	Asphalt/Tarmac (no coal tar)		
	Bitumen		
	Others		
	Other organics	0	
Other materials (%wt):	Boron shielding included in graphite %.		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs	0	
	Soil	0	
	Brick/Stone/Rubble	0	
	Cementitious material	0	
	Sand	0	
	Glass/Ceramics		
	Graphite	22.1	
	Desiccants/Catalysts	0	
	Asbestos	NE	
	Non/low friable		
	Moderately friable		
	Highly friable		
	Free aqueous liquids	0	
	Free non-aqueous liquids	0	
	Powder/Ash	0	

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Inorganic anions (%wt): There are no inorganic anions present.

Fluoride	0
Chloride	0
Iodide	0
Cyanide	0
Carbonate	0
Nitrate	0
Nitrite	0
Phosphate	0
Sulphate	0
Sulphide	0

Materials of interest for waste acceptance criteria: Possibly asbestos and trace quantities of sodium and potassium.

Combustible metals	
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: Small amounts of lead are 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.....

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

PACKAGING AND CONDITIONING

Conditioning method: Waste is to be packaged into either 6m³ concrete boxes or 500 l drum, dependant on activity.

Plant Name: DFR

Location: Dounreay

Plant startup date: NE

Total capacity (m³/y incoming waste): NE

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): NE

Other information: Plant still to be designed and packages yet to be fully confirmed.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
500 l drum	25.0	NE	0.5	NE
6m³ concrete box (SD)	75.0	NE	5.76	NE

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Likely container type comment:	Still to be fully determined following reactor characterisation.
Range in container waste volume:	Not established.
Other information on containers:	6m³ concrete boxes are reinforced concrete boxes.
Likely conditioning matrix:	Cement
Other information:	-
Conditioned density (t/m³):	~2.5
Conditioned density comment:	The density is likely to be around 2 - 3 t/m³.
Other information on conditioning:	-
Opportunities for alternative disposal routing:	Not yet determined

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source:	The main sources of activity are activated and contaminated equipment/structures.
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:	From LoC/10307096; LoC/10305789
Other information:	Specific Activities have been re-evaluated since the 2016 UK Inventory.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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			4.26E-01	C C 2	Gd 153				
Be 10			8.42E-07	C C 2	Ho 163			7.74E-07	C C 2
C 14			4.69E-02	C C 2	Ho 166m			8.30E-05	C C 2
Na 22					Tm 170				
Al 26					Tm 171			1.25E-07	C C 2
Cl 36			9.17E-06	C C 2	Lu 174			3.98E-07	C C 2
Ar 39			1.44E-01	C C 2	Lu 176			3.15E-10	C C 2
Ar 42			2.34E-09	C C 2	Hf 178n			1.59E-05	C C 2
K 40			1.15E-07	C C 2	Hf 182			5.04E-12	C C 2
Ca 41			1.62E-04	C C 2	Pt 193			5.36E-04	C C 2
Mn 53			2.22E-08	C C 2	Tl 204			1.67E-03	C C 2
Mn 54					Pb 205			1.30E-08	C C 2
Fe 55			9.81E-02	C C 2	Pb 210			3.20E-09	C C 2
Co 60			1.58E+00	C C 2	Bi 208			8.66E-08	C C 2
Ni 59			6.79E-02	C C 2	Bi 210m			1.51E-08	C C 2
Ni 63			3.53E+00	C C 2	Po 210			3.26E-09	C C 2
Zn 65					Ra 223			3.19E-07	C C 2
Se 79			2.15E-06	C C 2	Ra 225			4.04E-08	C C 2
Kr 81			9.98E-07	C C 2	Ra 226			2.48E-12	C C 2
Kr 85			9.37E-04	C C 2	Ra 228			3.88E-08	C C 2
Rb 87			1.04E-07	C C 2	Ac 227			4.18E-07	C C 2
Sr 90			1.05E-07	C C 2	Th 227			3.20E-07	C C 2
Zr 93			1.23E-06	C C 2	Th 228			3.74E-06	C C 2
Nb 91			4.48E-04	C C 2	Th 229			4.04E-08	C C 2
Nb 92			6.73E-08	C C 2	Th 230			1.72E-10	C C 2
Nb 93m			3.93E+00	C C 2	Th 232			3.88E-08	C C 2
Nb 94			3.86E-02	C C 2	Th 234			7.19E-08	C C 2
Mo 93			1.01E-01	C C 2	Pa 231			5.72E-07	C C 2
Tc 97			1.12E-08	C C 2	Pa 233			6.20E-09	C C 2
Tc 99			3.05E-03	C C 2	U 232			3E-05	C C 2
Ru 106			2.09E-17	C C 2	U 233			1.23E-05	C C 2
Pd 107			1.96E-09	C C 2	U 234			2.44E-07	C C 2
Ag 108m			1.10E-04	C C 2	U 235			3.26E-09	C C 2
Ag 110m					U 236			4.92E-10	C C 2
Cd 109			1.08E-09	C C 2	U 238			7.19E-08	C C 2
Cd 113m			6.83E-03	C C 2	Np 237			6.20E-09	C C 2
Sn 119m					Pu 236			3.31E-11	C C 2
Sn 121m			8.50E-04	C C 2	Pu 238			1.77E-05	C C 2
Sn 123					Pu 239			7.06E-05	C C 2
Sn 126			7.04E-12	C C 2	Pu 240			5.83E-06	C C 2
Sb 125			1.30E-05	C C 2	Pu 241			1.65E-05	C C 2
Sb 126					Pu 242			1.41E-10	C C 2
Te 125m			5.80E-17	C C 2	Am 241			2.43E-06	C C 2
Te 127m					Am 242m			9.82E-09	C C 2
I 129			7.25E-10	C C 2	Am 243			1.60E-10	C C 2
Cs 134			1.23E-06	C C 2	Cm 242			7.49E-13	C C 2
Cs 135			2.84E-09	C C 2	Cm 243			6.41E-10	C C 2
Cs 137			6.87E-06	C C 2	Cm 244			1.11E-09	C C 2
Ba 133			6.30E-03	C C 2	Cm 245			1.80E-13	C C 2
La 137			1.46E-05	C C 2	Cm 246			5.64E-15	C C 2
La 138			5.42E-12	C C 2	Cm 248			1.57E-20	C C 2
Ce 144					Cf 249				
Pm 145			9.96E-06	C C 2	Cf 250				
Pm 147			2.09E-07	C C 2	Cf 251				
Sm 147			5.15E-10	C C 2	Cf 252				
Sm 151			1.70E-04	C C 2	Other a				
Eu 152			1.40E-03	C C 2	Other b/g				
Eu 154			7.72E-04	C C 2	**Total a**	**0**		**1.44E-04**	**C C 2**
Eu 155			2.62E-05	C C 2	**Total b/g**	**0**		**9.98E+00**	**C C 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