

WASTE STREAM	5B304	Dounreay Fast Reactor ILW
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SITE Dounreay
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Dounreay Site Restoration Limited
WASTE TYPE ILW

Is the waste subject to Scottish Policy: Yes

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m ³
Future arisings -	1.4.2031 - 31.3.2032.....	11.5 m ³
	1.4.2032 - 31.3.2033.....	200.6 m ³
	1.4.2033 - 31.3.2034.....	43.3 m ³
Total future arisings:		255.4 m ³
Total waste volume:		255.4 m ³
Comment on volumes:	Arisings dates is based on provional LTP programme data. 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): Graphite (22.58%), Lead (0.11%), Mild Steel (0.05%), Stainless steel (77.26%),

Chemical state: Neutral

Chemical form of radionuclides: H-3: May be present in tritiated steel.
C-14: Will be present in graphite.
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): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	77.3	assumed to be 316L.	
Other ferrous metals.....	0.05	mild steel	
Iron.....			
Aluminium.....			
Beryllium.....			
Cobalt.....			

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Copper.....		
Lead.....	0.11	
Magnox/Magnesium.....		
Nickel.....		
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.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	TR		
Paper, cotton.....	TR		
Wood.....	TR		
Halogenated plastics	TR		
Total non-halogenated plastics.....	NE		
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 %.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....			
Graphite.....	22.6	Reactor Component	100.0
Desiccants/Catalysts.....	0		

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Asbestos.....	NE
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

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

	(%wt)	Type(s) and comment
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.

	(%wt)	Type(s) and comment
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.....		
Higher activity particles.....	NE	
Soluble solids as bulk chemical compounds.....	0	

Hazardous substances / non hazardous pollutants: Small amounts of lead are present.

	(%wt)	Type(s) and comment
Acrylamide.....		

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Benzene.....	NE
Chlorinated solvents.....	
Formaldehyde.....	
Organometallics.....	
Phenol.....	NE
Styrene.....	
Tri-butyl phosphate.....	NE
Other organophosphates.....	
Vinyl chloride.....	NE
Arsenic.....	NE
Barium.....	
Boron.....	NE
Boron (in Boral).....	
Boron (non-Boral).....	
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

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	0	

Potential for the waste to contain discrete items: Yes. There is the POTENTIAL for the waste to contain durable and/or engineered steel structures

PACKAGING AND CONDITIONING

Conditioning method: Current reference strategy is for packaging of ILW into 6m3 Concrete Boxes in a new facility at DFR

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Plant Name: Temporary Conditioning Plant
 Location: Dounreay
 Plant startup date: 2031
 Total capacity (m³/y incoming waste): ~201.0
 Target start date for packaging this stream: 2031
 Throughput for this stream (m³/y incoming waste): ~201.0
 Other information: Plant still to be designed and packages yet to be fully confirmed. Plant will be designed to handle required throughput.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	6m ³ concrete box (SD)	100.0	~3.45	5.76	75

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: Suitability for disposal in a Near Surface Disposal Facility has yet to be confirmed.
 Opportunities for alternative disposal routing: Not yet determined

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	Disposal at a Near Surface / Near Site Disposal Facility	~61.0	TBC	Low	It is possible that further characterisation will show that the Primary Circuit & Graphite can be categorised as Low Level Waste and will be suitable for disposal at DSRL's Low Level Waste Disposal Facility

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 --- APEC(08)P506
 Other information: Used 2019 UKRWI specific activities decayed to 2022.

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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			3.92E-01	CC 2	Gd 153				
Be 10			8.42E-07	CC 2	Ho 163			7.74E-07	CC 2
C 14			4.69E-02	CC 2	Ho 166m			8.29E-05	CC 2
Na 22					Tm 170				
Al 26					Tm 171			7.62E-08	CC 2
Cl 36			9.17E-06	CC 2	Lu 174			3.02E-07	CC 2
Ar 39			1.43E-01	CC 2	Lu 176			3.15E-10	CC 2
Ar 42			2.26E-09	CC 2	Hf 178n			1.53E-05	CC 2
K 40			1.14E-07	CC 2	Hf 182			5.04E-12	CC 2
Ca 41			1.62E-04	CC 2	Pt 193			5.25E-04	CC 2
Mn 53			2.21E-08	CC 2	Tl 204			1.29E-03	CC 2
Mn 54					Pb 205			1.30E-08	CC 2
Fe 55			6.87E-02	CC 2	Pb 210			3.06E-09	CC 2
Co 60			1.30E+00	CC 2	Bi 208			8.66E-08	CC 2
Ni 59			6.79E-02	CC 2	Bi 210m			1.51E-08	CC 2
Ni 63			3.49E+00	CC 2	Po 210			3.09E-09	CC 2
Zn 65					Ra 223			4.19E-07	CC 2
Se 79			2.15E-06	CC 2	Ra 225			4.20E-08	CC 2
Kr 81			9.98E-07	CC 2	Ra 226			2.59E-12	CC 2
Kr 85			8.52E-04	CC 2	Ra 228			3.88E-08	CC 2
Rb 87			1.03E-07	CC 2	Ac 227			4.25E-07	CC 2
Sr 90			1.01E-07	CC 2	Th 227			4.16E-07	CC 2
Zr 93			1.23E-06	CC 2	Th 228			1.39E-05	CC 2
Nb 91			4.48E-04	CC 2	Th 229			4.21E-08	CC 2
Nb 92			6.73E-08	CC 2	Th 230			1.76E-10	CC 2
Nb 93m			3.69E+00	CC 2	Th 232			3.88E-08	CC 2
Nb 94			3.86E-02	CC 2	Th 234			7.19E-08	CC 2
Mo 93			1.01E-01	CC 2	Pa 231			5.72E-07	CC 2
Tc 97			1.12E-08	CC 2	Pa 233			6.2E-09	CC 2
Tc 99			3.05E-03	CC 2	U 232			2.96E-05	CC 2
Ru 106			8.86E-18	CC 2	U 233			1.23E-05	CC 2
Pd 107			1.96E-09	CC 2	U 234			2.44E-07	CC 2
Ag 108m			1.10E-04	CC 2	U 235			3.26E-09	CC 2
Ag 110m					U 236			4.93E-10	CC 2
Cd 109			5.29E-10	CC 2	U 238			7.19E-08	CC 2
Cd 113m			6.34E-03	CC 2	Np 237			6.2E-09	CC 2
Sn 119m					Pu 236			2.36E-11	CC 2
Sn 121m			8.34E-04	CC 2	Pu 238			1.75E-05	CC 2
Sn 123					Pu 239			7.06E-05	CC 2
Sn 126			7.04E-12	CC 2	Pu 240			5.83E-06	CC 2
Sb 125			9.16E-06	CC 2	Pu 241			1.54E-05	CC 2
Sb 126					Pu 242			1.41E-10	CC 2
Te 125m			2.04E-06	CC 2	Am 241			2.46E-06	CC 2
Te 127m					Am 242m			9.74E-09	CC 2
I 129			7.25E-10	CC 2	Am 243			1.60E-10	CC 2
Cs 134			7.77E-07	CC 2	Cm 242			6.32E-09	CC 2
Cs 135			2.83E-09	CC 2	Cm 243			6.19E-10	CC 2
Cs 137			6.64E-06	CC 2	Cm 244			1.05E-09	CC 2
Ba 133			5.72E-03	CC 2	Cm 245			1.80E-13	CC 2
La 137			1.46E-05	CC 2	Cm 246			5.64E-15	CC 2
La 138			5.42E-12	CC 2	Cm 248			1.57E-20	CC 2
Ce 144					Cf 249				
Pm 145			9.40E-06	CC 2	Cf 250				
Pm 147			1.44E-07	CC 2	Cf 251				
Sm 147			5.15E-10	CC 2	Cf 252				
Sm 151			1.68E-04	CC 2	Other a				
Eu 152			1.30E-03	CC 2	Other b/g				
Eu 154			6.86E-04	CC 2	Total a	0	1.54E-04	CC 2	
Eu 155			2.13E-05	CC 2	Total b/g	0	9.37E+00	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