

WASTE STREAM	5B302-2	Prototype Fast Reactor Decom ILW (6m3 Box)
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SITE Dounreay

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025			
Future arisings:	1.4.2030 - 31.3.2031	0.8		
	1.4.2033 - 31.3.2034	0.9		
	1.4.2034 - 31.3.2035	0.9		
	1.4.2035 - 31.3.2036	0.9		
	1.4.2036 - 31.3.2037	0.3		
	1.4.2041 - 31.3.2042	0.7		
	1.4.2042 - 31.3.2043	6.9		
	1.4.2043 - 31.3.2044	6.9		
	1.4.2044 - 31.3.2045	6.9		
	1.4.2045 - 31.3.2046	6.9		
	1.4.2046 - 31.3.2047	0.2		
Total future arisings:		32.4		
Total waste volume:		32.4		

Number of waste packages in stock: At 1.4.2025..... - packages

Comment on arising rates: Arisings dates are based on the Dounreay Lifetime Plan 2024 dataset generated in December 2023.

Additional information on quantities: NRS Dounreay are undertaking further sampling to improve understanding of tritium context of reactor items to confirm if they are ILW or LLW.

Uncertainty factors on volumes: Stock (upper): x - Arisings (upper): x 1.20
Stock (lower): x - Arisings (lower): x 0.80

WASTE SOURCE Reactor Decommissioning.

PHYSICAL CHARACTERISTICS

General description: The future arisings comprise reactor components and construction materials; All components will be size reduced during decommissioning operations.

Changes since waste generated: -

Bulk density (t/m³): = 1.5

Comment on density: Based on actuals data from Dounreay's waste consignment system. Data considered acceptable for 2025 submission.

CHEMICAL COMPOSITION

General description and components (%wt): Cementitious material (e.g. concrete) (2.59%), Graphite (37.37%), Mild Steel (3.63%), Stainless steel (56.40%).

Chemical state: Neutral

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 56.4	C14 from activated steels in reactor.	45.0
Other ferrous metals.....	= 3.6		
Iron.....	0		
Aluminium.....	= 0		
Beryllium.....	= 0		
Cobalt.....	= 0		
Copper.....	= 0		
Lead.....	= 0		
Magnox/Magnesium.....	= 0		
Nickel.....	= 0		
Titanium.....	= 0		
Uranium.....	= 0		
Zinc.....	= 0		
Zircaloy/Zirconium.....	= 0		
Other metals.....	= 0		

Organics (%wt):

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

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 0		55.0
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	= 2.6		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	= 37.4		
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....	NE		
Moderately friable.....	NE		
Highly friable.....	NE		
Free aqueous liquids.....	= 0		
Free non-aqueous liquids.....	= 0		
Powder/Ash.....	= 0		

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	= 0	
Chloride.....	NE	
Iodide.....	NE	
Cyanide.....	= 0	
Carbonate.....	NE	
Nitrate.....	NE	
Nitrite.....	NE	
Phosphate.....	= 0	
Sulphate.....	= 0	
Sulphide.....	NE	

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	NE	-
Low flash point liquids.....	NE	-
Explosive materials.....	NE	-
Phosphorus.....	NE	-
Hydrides.....	NE	-
Biological etc. materials.....	NE	-
Biodegradable materials.....	= 0	-
Putrescible wastes.....		
Non-putrescible wastes.....	NE	-
Corrosive materials.....	NE	-
Pyrophoric materials.....	NE	-
Generating toxic gases.....	NE	-
Reacting with water.....	= 0	-
Higher activity particles.....	NE	-
Soluble solids as bulk chemical compounds.....	NE	-

Hazardous substances / non hazardous pollutants:

-

	(%wt)	Type(s) and comment
Acrylamide.....	NE	-
Benzene.....	0	-
Chlorinated solvents.....	NE	-
Formaldehyde.....	NE	-
Organometallics.....	NE	-
Phenol.....	NE	-
Styrene.....	NE	-
Tri-butyl phosphate.....	NE	-
Other organophosphates.....	NE	-
Vinyl chloride.....		-
Arsenic.....	0	-
Barium.....	NE	-
Boron.....	0	-
Boron (in Boral).....	NE	-
Boron (non-Boral).....	NE	-
Cadmium.....	0	-
Caesium.....	NE	-
Selenium.....	0	-
Chromium.....	0	-
Molybdenum.....	0	-
Thallium.....	NE	-
Tin.....	0	-
Vanadium.....	0	-
Mercury compounds.....	0	-
Others.....	NE	-

Complexing agents (%wt):

Not yet determined

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

Physical components:

	Number	Type(s) and comment
Sources.....	= 0	-
Electronic & Electrical Equipment (EEE)		
EEE Type 1.....	= 0	-
EEE Type 2.....	= 0	-
EEE Type 3.....	= 0	-
EEE Type 4.....	= 0	-
EEE Type 5.....	= 0	-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction Decay storage Low force compaction Supercompaction (HFC) Incineration Drying/dewatering/liquid separation Tie down/fixatives/strippable coating/painting application Decontamination Metal treatment Recycling / reuse Thermal treatment, including vitrification Encapsulation Polymer encapsulation Other physical treatment Other chemical treatment Containerisation Treatment not yet determined None	On-site	= 100.0

Comments on planned treatments:

The waste will be loaded into 6m³ boxes and encapsulated at the PFR ILW Size Reduction Facility.

Conditioning method:

The waste will be loaded into 6m³ boxes and encapsulated at the PFR Size Reduction Facility. The Facility is still in design phase.

Conditioning plants:

Plant Name	Location
ILW Size Reduction Facility	Dounreay

Likely conditioning matrix:

Unknown

Further information on the conditioning matrix:

HD Grout for 6m³ concrete boxes.

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m ³)	Payload (m ³)	Number of packages	Estimated start date for packaging
6 m ³ concrete box (HD)	100.0	2.9	5.7	12	-

Range in container waste loading: The 6m³ Concrete Box loading may range from 0.34m³ to 3.72m³.

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

> 2.5

Conditioned density comment:

The density is likely to be around 2.6 - 4.1t/m³ for 6m³ concrete boxes.

Management Routes:

Disposal Route	Stream volume %	Raw density t/m ³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	= 100.0		
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: Main sources are activated and contaminated reactor components, equipment, tools and structure.

Uncertainty: There is on-going work to confirm if a proportion of the waste is dominated by tritium which then may impact on waste treatment options.

Measurement of radioactivities: The activity in both the stocks and the arisings is derived from LoC information. As the LoC accounts for all wastes from 5B302-1, 5B302-2, and 5B302-3, the fingerprint will remain the same.

Chemical form of radionuclides:

- H-3: Present in activated steels.
- C-14: Present in activated graphite and steels.
- Cl-36: -
- Se-79: -
- Tc-99: -
- I-129: Likely to be present at low levels.
- Ra: Not known to be present.
- Th: Not known to be present.
- U: Likely to be present at low levels.
- Np: Likely to be present at low levels.
- Pu: Likely to be present at low levels.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3			= 1.92E-02	C C 2	Gd 153			= 1.07E-09	C C 2
Be 10			= 5.10E-08	C C 2	Ho 163			= 1.27E-25	C C 2
C 14			= 1.94E-03	C C 2	Ho 166m			= 6.54E-06	C C 2
Na 22			= 5.18E-07	C C 2	Tm 170			= 2.53E-11	C C 2
Al 26					Tm 171				
Cl 36			= 2.94E-07	C C 2	Lu 174			= 2.47E-11	C C 2
Ar 39			= 6.96E-05	C C 2	Lu 176			= 8.79E-11	C C 2
Ar 42			= 1.76E-10	C C 2	Hf 178n			= 3.85E-06	C C 2
K 40			= 8.54E-06	C C 2	Hf 182			= 3.08E-06	C C 2
Ca 41			= 1.04E-05	C C 2	Pt 193			= 5.51E-05	C C 2
Mn 53			= 2.01E-08	C C 2	Ti 204			= 1.66E-06	C C 2
Mn 54			= 1.97E-08	C C 2	Pb 205			= 6.89E-06	C C 2
Fe 55			= 4.25E-05	C C 2	Pb 210			= 1.71E-05	C C 2
Co 60			= 6.25E-02	C C 2	Bi 208			= 5.81E-10	C C 2
Ni 59			= 2.70E-03	C C 2	Bi 210m			= 2.64E-07	C C 2
Ni 63			= 1.92E-01	C C 2	Po 210			= 1.71E-05	C C 2
Zn 65			= 1.19E-08	C C 2	Ra 223			= 2.47E-11	C C 2
Se 79			= 1.13E-07	C C 2	Ra 225			= 1.18E-07	C C 2
Kr 81			= 1.14E-06	C C 2	Ra 226			= 1.70E-05	C C 2
Kr 85			= 2.11E-05	C C 2	Ra 228			= 5.86E-10	C C 2
Rb 87			= 3.52E-09	C C 2	Ac 227			= 2.53E-11	C C 2
Sr 90			= 7.48E-06	C C 2	Th 227			= 2.46E-11	C C 2
Zr 93			= 2.52E-08	C C 2	Th 228			= 3.88E-09	C C 2
Nb 91					Th 229			= 1.18E-07	C C 2
Nb 92			= 1.15E-10	C C 2	Th 230			= 1.85E-09	C C 2
Nb 93m			= 1.14E-03	C C 2	Th 232			= 6.04E-10	C C 2
Nb 94			= 5.63E-04	C C 2	Th 234			= 1.45E-09	C C 2
Mo 93			= 9.22E-04	C C 2	Pa 231			= 1.89E-10	C C 2
Tc 97			= 1.39E-11	C C 2	Pa 233			= 3.09E-10	C C 2
Tc 99			= 8.93E-05	C C 2	U 232			= 3.23E-09	C C 2
Ru 106			= 2.89E-07	C C 2	U 233			= 4.19E-07	C C 2
Pd 107			= 5.55E-10	C C 2	U 234			= 3.85E-07	C C 2
Ag 108m			= 1.24E-05	C C 2	U 235			= 7.12E-07	C C 2
Ag 110m			= 7.79E-09	C C 2	U 236			= 3.93E-11	C C 2
Cd 109			= 1.28E-14	C C 2	U 238			= 1.45E-09	C C 2
Cd 113m			= 1.11E-05	C C 2	Np 237			= 3.09E-10	C C 2
Sn 119m			= 6.97E-23	C C 2	Pu 236			= 9.54E-11	C C 2
Sn 121m			= 7.41E-06	C C 2	Pu 238			= 7.19E-06	C C 2
Sn 123					Pu 239			= 2.06E-05	C C 2
Sn 126			= 1.39E-09	C C 2	Pu 240			= 4.42E-06	C C 2
Sb 125			= 1.52E-06	C C 2	Pu 241			= 3.39E-05	C C 2
Sb 126			= 1.39E-09	C C 2	Pu 242			= 2.29E-06	C C 2
Te 125m			= 3.60E-07	C C 2	Am 241			= 1.67E-05	C C 2
Te 127m					Am 242m			= 8.14E-05	C C 2
I 129			= 1.73E-11	C C 2	Am 243			= 2.60E-05	C C 2
Cs 134			= 3.42E-07	C C 2	Cm 242			= 6.80E-05	C C 2
Cs 135			= 1.78E-07	C C 2	Cm 243			= 1.99E-07	C C 2
Cs 137			= 7.82E-05	C C 2	Cm 244			= 3.94E-07	C C 2
Ba 133			= 1.58E-05	C C 2	Cm 245			= 7.90E-06	C C 2
La 137					Cm 246			= 2.14E-08	C C 2
La 138			= 4.62E-05	C C 2	Cm 248			= 2.50E-18	C C 2
Ce 144			= 1.65E-08	C C 2	Cf 249			= 3.74E-09	C C 2
Pm 145			= 1.39E-07	C C 2	Cf 250			= 5.83E-12	C C 2
Pm 147			= 5.38E-22	C C 2	Cf 251			= 4.46E-12	C C 2
Sm 147			= 6.54E-13	C C 2	Cf 252			= 8.69E-14	C C 2
Sm 151			= 7.02E-06	C C 2	Unsp a				
Eu 152			= 6.17E-05	C C 2	Unsp b/g				
Eu 154			= 2.32E-05	C C 2	Total a	0	*	1.90E-04	*
Eu 155			= 5.12E-06	C C 2	Total b/g	0	*	2.81E-01	*

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 the 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
* Total calculated from the 114 declared radionuclides