

WASTE STREAM	5B03	Operational RHILW
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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:	= 142.4			
Total future arisings:	0.0			
Total waste volume:	142.4			

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

Comment on arising rates: All other future solid RHILW arisings will be consigned under UKRWI decommissioning waste streams.

Additional information on quantities: All drums have been overpacked in 330 litre drums and in the Dounreay Cementation Plant Store. The additional volume attributable to these overpacks is not included as it is undecided if they will remain part of the waste stream.

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

WASTE SOURCE The waste arises from PFR fuel cycle, including operations and support. It consists of both irradiated and contaminated items. The earliest waste has been in storage since 1980, the start of PFR fuel reprocessing.

PHYSICAL CHARACTERISTICS

General description: The waste consists of items such as hulls, centrifuge bowls, plenums, wrappers and other assorted scrap such as redundant equipment and tools. It arises from both reactor fuel breakdown and post irradiation examination support work. All waste is stored in 160L baskets within 200 litre stainless steel drums. All drums have been overpacked in 330 litre drums.

Changes since waste generated: -

Bulk density (t/m³): = 1.3

Comment on density: The raw density of 1.315 te/m³ is based on a sample of 859 drums (171.8 m³) with a total weight of 225.911 te.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless steel (79.64%), mild steel (12.51%), glass (0.4%), residues (1.4%), lead (0.64%), copper (0.21%), paper (0.8%), plastic (3.5%), PVC (<0.1%), rubber (<0.1%), other material (<0.9%).

Chemical state: Neutral

Sheet metal proportion / thickness: Both sheet (e.g. drum, hulls) and bulk (e.g. tools) metals are likely to be present. Proportions not estimated.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 79.6	Assumed to be mainly 316.	79.6
Other ferrous metals.....	= 12.5	-	12.5
Iron.....	-	-	-
Aluminium.....	TR	-	-
Beryllium.....	= 0	-	0.2
Cobalt.....	= 0	-	0.6
Copper.....	= 0.21	-	-
Lead.....	= 0.64	-	-
Magnox/Magnesium.....	= 0	-	-
Nickel.....	-	-	-
Titanium.....	-	-	-
Uranium.....	= 0	-	-
Zinc.....	= 0	-	-
Zircaloy/Zirconium.....	= 0	-	-
Other metals.....	= 0	-	-

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 0.80	-	0.8
Paper, cotton.....	= 0.80	-	0.8
Wood.....	= 0	-	
Halogenated plastics.....	= 3.5	-	3.5
Total non-halogenated plastics.....	< 0.10	-	0.1
Condensation polymers.....	NE	-	
Others.....	NE	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	< 0.10	-	0.1
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.....	< 2.1	Residues + other material - no further breakdown available	2.1

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	NE	-	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	= 0	-	
Sand.....	= 0	-	
Glass/Ceramics.....	= 0.40	-	0.4
Graphite.....	= 0	-	
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.....	TR	-
Iodide.....	NE	-
Cyanide.....	NE	-
Carbonate.....	NE	-
Nitrate.....	TR	-
Nitrite.....	= 0	-
Phosphate.....	NE	-
Sulphate.....	TR	-
Sulphide.....	NE	-

Materials of interest for waste acceptance criteria:

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

Hazardous substances / non hazardous pollutants:

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

Complexing agents (%wt):

Yes		
	(%wt)	Type(s) and comment
EDTA.....	NE	-
DPTA.....	NE	-
NTA.....	NE	-
Polycarboxylic acids.....	NE	-
Other organic complexants.....	TR	There may be trace quantities of complexing agents present.
Total complexing agents.....	TR	-

Physical components:

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

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction	On-site	= 100.0
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		

Comments on planned treatments:

Legacy RHILW will be decanted from existing Z6033 200L drums and grouted into 500L drums. On average, 3 200L drums worth of waste should fit into 2 500L drums.

Conditioning method:

Waste will be conditioned using a grout matrix into 500L drums. This will be done through a dedicated ILW repackaging facility, which will handle both RHILW and CHILW 200L drums. This facility will produce conditioned 500L drums.

Conditioning plants:

Plant Name	Location
Combined ILW Repackaging Facility	Dounreay

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

Dounreay uses OPC 1:3 PFA 42% water. Ref: APEC(05)458 4.1.1

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	500 l drum (basket for waste)	100.0	0.30	0.50	475	-

Range in container waste loading: Waste loading will be variable and dependant on nuclear material content of the wastes.
Assume 3:2 Z6033 to 500L drum ratio. Assume Z6033 loading @ 0.2m³ = 0.6m³ in 2 500L drums (1m³) = 0.3m³ per 500L drum.

Other information on packaging and conditioning: -

Conditioned density (t/m³): ~ 2.5
Conditioned density comment: Density is if waste is grouted directly into 500 litre drums. Assume density similar to CHILW repack. APEC(05)458 4.2.2.1

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	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: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
Non-NSDF HAW	Dounreay LLWDV	NE	RED	There is potential for LLW to be diverted out of this stream during repackaging of ILW into 500L drums. However, details of this will be confirmed through the design process of the repackaging facility.

RADIOACTIVITY

Source: The main sources of activity are activated and contaminated fuel element debris and cladding and contaminated redundant equipment and tools.

Uncertainty: -

Measurement of radioactivities: The specific activity data has been derived from LoC data.

Chemical form of radionuclides: H-3: Likely to be present, form uncertain.
C-14: Likely to be present, form uncertain.
Cl-36: Likely to be present, form uncertain.
Se-79: Likely to be present, form uncertain.
Tc-99: Likely to be present, form uncertain.
I-129: Likely to be present, form uncertain.
Ra: Likely to be present, form uncertain.
Th: Likely to be present, form uncertain.
U: Likely to be present as oxide.
Np: Likely to be present, form uncertain.
Pu: Likely to be present as oxide.

WASTE STREAM		5B03		Operational RHILW					
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	= 7.98E-02	B B 2			Gd 153				
Be 10	= 5.48E-07	B B 2			Ho 163				
C 14	= 1.02E-02	B B 2			Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41	= 1.44E-05	B B 2			Pt 193				
Mn 53	= 8.76E-03	B B 2			Tl 204				
Mn 54	= 5.82E-10	B B 2			Pb 205				
Fe 55	= 4.16E-02	B B 2			Pb 210	= 9.61E-13	B B 2		
Co 60	= 5.43E+00	B B 2			Bi 208				
Ni 59	= 3.41E-02	B B 2			Bi 210m				
Ni 63	= 8.85E+00	B B 2			Po 210	= 8.90E-13	B B 2		
Zn 65	= 2.93E-15	B B 2			Ra 223	= 1.84E-11	B B 2		
Se 79	= 1.84E-05	B B 2			Ra 225	= 4.12E-09	B B 2		
Kr 81					Ra 226	= 5.23E-12	B B 2		
Kr 85					Ra 228	= 8.46E-17	B B 2		
Rb 87					Ac 227	= 1.92E-11	B B 2		
Sr 90	= 1.01E+00	B B 2			Th 227	= 1.85E-11	B B 2		
Zr 93	= 1.68E-04	B B 2			Th 228	= 3.44E-10	B B 2		
Nb 91					Th 229	= 4.13E-09	B B 2		
Nb 92					Th 230	= 1.25E-09	B B 2		
Nb 93m	= 3.78E-02	B B 2			Th 232	= 1.60E-16	B B 2		
Nb 94	= 3.17E-03	B B 2			Th 234	= 1.04E-05	B B 2		
Mo 93	= 1.89E-02	B B 2			Pa 231	= 2.27E-10	B B 2		
Tc 97					Pa 233	= 6.60E-06	B B 2		
Tc 99	= 9.09E-04	B B 2			U 232				
Ru 106	= 1.47E-07	B B 2			U 233	= 1.82E-06	B B 2		
Pd 107					U 234	= 8.72E-06	B B 2		
Ag 108m	= 1.46E-04	B B 2			U 235	= 5.00E-07	B B 2		
Ag 110m	= 1.15E-14	B B 2			U 236	= 2.74E-07	B B 2		
Cd 109					U 238	= 1.04E-05	B B 2		
Cd 113m	= 1.13E-03	B B 2			Np 237	= 6.62E-06	B B 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238	= 8.79E-02	B B 2		
Sn 123					Pu 239	= 4.19E-01	B B 2		
Sn 126	= 3.32E-05	B B 2			Pu 240	= 3.89E-01	B B 2		
Sb 125	= 3.60E-04	B B 2			Pu 241	= 5.34E+00	B B 2		
Sb 126	= 3.32E-05	B B 2			Pu 242	= 3.38E-04	B B 2		
Te 125m	= 8.52E-05	B B 2			Am 241	= 6.51E-01	B B 2		
Te 127m					Am 242m	= 5.75E-02	B B 2		
I 129	= 1.55E-06	B B 2			Am 243	= 5.69E-04	B B 2		
Cs 134	= 1.17E-04	B B 2			Cm 242	= 4.80E-02	B B 2		
Cs 135	= 2.90E-05	B B 2			Cm 243	= 2.69E-03	B B 2		
Cs 137	= 2.96E+00	B B 2			Cm 244	= 2.01E-01	B B 2		
Ba 133					Cm 245	= 7.94E-06	B B 2		
La 137					Cm 246	= 7.93E-07	B B 2		
La 138					Cm 248				
Ce 144	= 2.43E-11	B B 2			Cf 249				
Pm 145					Cf 250				
Pm 147	= 2.58E-03	B B 2			Cf 251				
Sm 147	= 1.65E-11	B B 2			Cf 252				
Sm 151	= 1.20E-01	B B 2			Unsp a				
Eu 152	= 6.98E-02	B B 2			Unsp b/g				
Eu 154	= 2.91E-02	B B 2			Total a	1.80E+00	*	0	*
Eu 155	= 1.02E-02	B B 2			Total b/g	2.41E+01	*	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 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