

WASTE STREAM	5B363	Effluent Treatment Plant ILW
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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:	1.4.2025 - 31.3.2026	= 0.6		
	1.4.2026 - 31.3.2027	= 1.5		
	1.4.2027 - 31.3.2028	= 1.1		
	1.4.2030 - 31.3.2031	= 0.8		
	1.4.2031 - 31.3.2032	= 3.3		
	1.4.2032 - 31.3.2033	= 3.3		
	1.4.2033 - 31.3.2034	= 3.3		
	1.4.2034 - 31.3.2035	= 3.3		
	1.4.2035 - 31.3.2036	= 3.3		
	1.4.2036 - 31.3.2037	= 3.3		
	1.4.2037 - 31.3.2038	= 3.3		
	1.4.2038 - 31.3.2039	= 3.3		
	1.4.2039 - 31.3.2040	= 3.3		
	1.4.2040 - 31.3.2041	= 3.3		
	1.4.2041 - 31.3.2042	= 3.3		
	1.4.2042 - 31.3.2043	= 3.3		
	1.4.2043 - 31.3.2044	= 3.3		
	1.4.2044 - 31.3.2045	= 3.3		
	1.4.2045 - 31.3.2046	= 3.3		
	1.4.2046 - 31.3.2047	= 1.6		
Total future arisings:		55.7		
Total waste volume:		55.9		

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

Comment on arising rates: Arisings dates are based on NRS Dounreay's Lifetime Plan 2024 as generated at December 2023.

Additional information on quantities: The volume has increased as expected future arisings from a new Effluent Treatment Plant to be built within the existing footprint of the facility. This waste is contained mostly within a concrete tank with a small amount in the Pump Well valves. Conditions do not allow access to the waste within the tank therefore an assumption has been made as to the waste volume; this could be a maximum of 5m³. An LoC is to be produced to capture this waste stream.

Uncertainty factors on volumes: Stock (upper): x 1.02 Arisings (upper): x 1.10
Stock (lower): x 0.98 Arisings (lower): x 0.90

WASTE SOURCE Sludge arising from historic operation of D1211. Also includes future arisings from treatment of shaft and silo effluent.

PHYSICAL CHARACTERISTICS

General description: There is existing sludge from historical operations within a sump area; The new effluent treatment plant will produce a dried product that may be placed in interim storage before being processed through the Shaft and Silo packaging plant.

Changes since waste generated: -

Bulk density (t/m³): = 0.30

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

CHEMICAL COMPOSITION

General description and components (%wt): Inorganic sludges and flocs which will be evaporated into a powder (94.25%), Inorganic sludges and flocs (5.39%) Mild Steel (0.36%),

Chemical state: Neutral

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0	-	
Other ferrous metals.....	= 0.36	Mild Steel	
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	-	
Inorganic sludges and flocs.....	= 5.4	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	= 0	-	
Sand.....	= 0	-	
Glass/Ceramics.....	= 0	-	
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.....	= 94.3	evaporated effluent	

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.....	NE	-
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.....	NE	-
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	On-site	= 95.0
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation	On-site	= 95.0
Tie down/fixatives/strippable coating/painting application	On-site	= 100.0
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:

The new Effluent Treatment Plant is expected to produce a significant quantity of ILW through the filtration and drying of effluent from Shaft and Silo. The resulting powder in 200L drums will be compacted into pucks and placed into 500L drums for encapsulation. The remainder will be sludges from the existing facility.

Conditioning method:

The new Effluent Treatment Plant is expected to produce a significant quantity of ILW through the filtration and drying of effluent from Shaft and Silo. The remainder will be sludges from the existing facility but the final conditioning route is still to be confirmed.

Conditioning plants:

Plant Name	Location
Shaft & Silo Retrieval and Processing Facility	Dounreay

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

Dounreay uses: 1:3 OPC:PFA, 42% Water.

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 (pucks)	95.0	0.51	0.40	106	-
Not yet determined	5.0	-	-	-	-

Range in container waste loading:

Assume 105 500L drums for ETP - wasteroute strategy is still being developed and may change. An equivalent to 12 500L drums for existing sludge (manual calc). However, the method for treating the existing sludge is still in discussion and a final strategy is yet to be produced.

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

~ 2.5

Conditioned density comment:

-

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: Not yet determined

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

RADIOACTIVITY

Source: Sludge comprises of contaminated particles that has originated from active effluent discharges from Reactor and reprocessing facilities.

Uncertainty: Based on sample results 'D1211 Seaward pipe 1,2,3', which is sampling the same pipework the sludge has been identified as contained within. Effluent Treatment Plant is still in design phase and no defined activity assessment has been made on its future arisings.

Measurement of radioactivities: Sample analysis. Specific activity derived using 2019 UKRWI data decayed to 2022.

Chemical form of radionuclides: H-3: -
C-14: -
Cl-36: -
Se-79: -
Tc-99: -
I-129: -
Ra: -
Th: -
U: -
Np: -
Pu: -

WASTE STREAM 5B363 Effluent Treatment Plant ILW									
Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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					Gd 153				
Be 10					Ho 163				
C 14					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					Pt 193				
Mn 53					Ti 204				
Mn 54					Pb 205				
Fe 55					Pb 210	= 1.45E-13	B B 1	= 1.45E-13	B B 1
Co 60	= 4.79E-06	B B 1	= 4.79E-06	B B 1	Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	= 1.11E-13	B B 1	= 1.11E-13	B B 1
Zn 65					Ra 223	= 2.07E-11	B B 1	= 2.07E-11	B B 1
Se 79					Ra 225	= 1.52E-17	B B 1	= 1.52E-17	B B 1
Kr 81					Ra 226	= 2.45E-12	B B 1	= 2.45E-12	B B 1
Kr 85					Ra 228	= 1.62E-16	B B 1	= 1.62E-16	B B 1
Rb 87					Ac 227	= 2.15E-11	B B 1	= 2.15E-11	B B 1
Sr 90	= 1.55E-03	B B 1	= 1.55E-03	B B 1	Th 227	= 2.07E-11	B B 1	= 2.07E-11	B B 1
Zr 93					Th 228	= 7.65E-17	B B 1	= 7.65E-17	B B 1
Nb 91					Th 229	= 1.56E-17	B B 1	= 1.56E-17	B B 1
Nb 92					Th 230	= 1.89E-09	B B 1	= 1.89E-09	B B 1
Nb 93m					Th 232	= 5.61E-16	B B 1	= 5.61E-16	B B 1
Nb 94	= 2.11E-05	B B 1	= 2.11E-05	B B 1	Th 234	= 1.89E-06	B B 1	= 1.89E-06	B B 1
Mo 93					Pa 231	= 2.40E-10	B B 1	= 2.40E-10	B B 1
Tc 97					Pa 233	= 6.69E-09	B B 1	= 6.69E-09	B B 1
Tc 99					U 232				
Ru 106					U 233	= 8.47E-14	B B 1	= 8.47E-14	B B 1
Pd 107					U 234	= 3.43E-05	B B 1	= 3.43E-05	B B 1
Ag 108m					U 235	= 1.89E-06	B B 1	= 1.89E-06	B B 1
Ag 110m					U 236	= 1.89E-06	B B 1	= 1.89E-06	B B 1
Cd 109					U 238	= 1.89E-06	B B 1	= 1.89E-06	B B 1
Cd 113m					Np 237	= 6.81E-09	B B 1	= 6.81E-09	B B 1
Sn 119m					Pu 236				
Sn 121m					Pu 238	= 6.80E-03	B B 1	= 6.80E-03	B B 1
Sn 123					Pu 239	= 5.49E-03	B B 1	= 5.49E-03	B B 1
Sn 126					Pu 240	= 2.96E-03	B B 1	= 2.96E-03	B B 1
Sb 125					Pu 241	= 2.82E-02	B B 1	= 2.82E-02	B B 1
Sb 126					Pu 242				
Te 125m					Am 241	= 3.64E-03	B B 1	= 3.64E-03	B B 1
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137	= 1.15E-02	B B 1	= 1.15E-02	B B 1	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Unsp a				
Eu 152					Unsp b/g				
Eu 154	= 6.50E-06	B B 1	= 6.50E-06	B B 1	Total a	1.89E-02	*	1.89E-02	*
Eu 155					Total b/g	4.13E-02	*	4.13E-02	*

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