

WASTE STREAM	5B22	ADU Floc
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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 = 141.0			
Future arisings:	1.4.2026 - 31.3.2027 16.0			
Total future arisings:	16.0			
Total waste volume:	157.0			

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

Comment on arising rates: Future arisings consist of nitric acid tank washings which will occur after processing of ADU Floc. This additional waste may move to a different UKRWI wastestream pending further review.

Additional information on quantities: Stocks figure has been adjusted using recent updates to ADU Floc datasheets. 140.97m³ is the raw waste. There is expected to be an addition of ~65m³ of conditioning liquors to the stocks that has not been represented here but will be reflected in the conditioned density. This wastestream will also produce an addition of 16 m³ of future arisings as an allowance for Nitric Acid Tank Washings

Uncertainty factors on volumes: Stock (upper): x 1.05 Arisings (upper): x 1.20
Stock (lower): x 0.95 Arisings (lower): x 0.80

WASTE SOURCE The floc results from the decontamination of high alpha MA/LA liquors from the PFR fuel reprocessing plant.

PHYSICAL CHARACTERISTICS

General description: The waste is an alpha and beta/gamma contaminated ammonium diuranate (ADU) floc. There are no large items present.

Changes since waste generated: Addition of Nitric acid from tank washouts and NaOH to neutralise resulting solution

Bulk density (t/m³): = 1.3

Comment on density: Density includes addition of approx 20m³ of nitric acid and 45m³ of NaOH as pre treatment to the wasteform.

CHEMICAL COMPOSITION

General description and components (%wt): Other Liquid (100.00%).

Chemical state: Alkali

Sheet metal proportion / thickness: The waste contains only metal ions in solution.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0	-	
Other ferrous metals.....	= 0	-	
Iron.....	P	Iron Hydroxide / Iron Phosphate (ILoC)	
Aluminium.....	TR	-	
Beryllium.....	= 0	-	
Cobalt.....	= 0	-	
Copper.....	= 0	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	= 0	-	
Titanium.....	0	-	
Uranium.....	TR	-	
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.....	= 0	-	
Others.....	= 0	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	= 0	-	
Halogenated rubber.....	= 0	-	
Non-halogenated rubber.....	= 0	-	
Hydrocarbons.....	= 0	-	
Oil or grease.....	= 0	-	
Fuel.....	= 0	-	
Asphalt/Tarmac (cont.coal tar).....	= 0	-	
Asphalt/Tarmac (no coal tar).....	= 0	-	
Bitumen.....	= 0	-	
Others.....	= 0	-	
Other organics.....	= 0	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 0	-	
Inorganic sludges and flocs.....	= 100.0	ADU Flocc	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	= 0	-	
Sand.....	= 0	-	
Glass/Ceramics.....	= 0	-	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	= 0	-	
Asbestos.....	= 0	-	
Non/low friable.....	= 0	-	
Moderately friable.....	= 0	-	
Highly friable.....	= 0	-	
Free aqueous liquids.....	= 0	-	
Free non-aqueous liquids.....	TR	-	
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.....	= 0	-
Cyanide.....	= 0	-
Carbonate.....	= 0	-
Nitrate.....	~ 6.3	-
Nitrite.....	= 0	-
Phosphate.....	~ 2.7	-
Sulphate.....	~ 2.5	-
Sulphide.....	= 0	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	= 0	-
Low flash point liquids.....	= 0	-
Explosive materials.....	= 0	-
Phosphorus.....	P	Present as part of TBP and degradation products (ILOC)
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.....	= 0	-
Benzene.....	NE	-
Chlorinated solvents.....	= 0	-
Formaldehyde.....	= 0	-
Organometallics.....	= 0	-
Phenol.....	NE	-
Styrene.....	= 0	-
Tri-butyl phosphate.....	TR	Potential for it to be present along with degradation products (ILoC)
Other organophosphates.....	= 0	-
Vinyl chloride.....	NE	-
Arsenic.....	NE	-
Barium.....	= 0	-
Boron.....	NE	-
Boron (in Boral).....	= 0	-
Boron (non-Boral).....	= 0	-
Cadmium.....	NE	-
Caesium.....	= 0	-
Selenium.....	NE	-
Chromium.....	NE	-
Molybdenum.....	NE	-
Thallium.....	= 0	-
Tin.....	NE	-
Vanadium.....	NE	-
Mercury compounds.....	= 0	-
Others.....	NE	-

Complexing agents (%wt):

Yes		
	(%wt)	Type(s) and comment
EDTA.....	= 0	-
DPTA.....	= 0	-
NTA.....	= 0	-
Polycarboxylic acids.....	= 0	-
Other organic complexants.....	TR	The waste contains small amounts of degraded TBP, DBP, MBP and kerosene.
Total complexing agents.....	TR	-

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	= 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:

ADU Floc may have to be dissolved in nitric acid to allow transfer of the Floc to a reaction vessel where it will be conditioned with sodium hydroxide. Current strategy indicates that the waste will then be transferred to a dedicated facility for cementation into 500L drums although an alternative processing route is being investigated.

Conditioning method:

Current strategy indicates that the dissolved ADU floc will be added to NaOH, producing NaDU slurry which would be cemented into 500 litre drums. The waste will be transferred to a dedicated facility for cementation into 500 l drums.

Conditioning plants:	Plant Name	Location
	ADU Floc Cementation Plant	Dounreay

Likely conditioning matrix: Non-standard

Further information on the conditioning matrix: Dounreay will use Cement PFA 1:1 OPC.

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 (paddle)	100.0	0.27	0.50	574	-

Range in container waste loading: Latest estimate assumes around 573 drums after addition of uranyl nitrate.

Other information on packaging and conditioning: -

Conditioned density (t/m³): ~ 1.7

Conditioned density comment: Density is likely to be around 1.7 t/m³ once conditioned and cemented. Confirmed by updated ADU Floc datasheets.

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: No

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

RADIOACTIVITY

Source: Main source or radioactivity is fission products with AM-241, Cm-243 and plutonium (alpha).

Uncertainty: Accuracy of tank analysis to within a factor of three. Radionuclides have been re-assessed.

Measurement of radioactivities: The specific activities of the principal radionuclides were measured by sampling followed by radiochemical analysis in 2006 and 2011 and adjusted to align with Nuclear Material Accountancy records. Other specific activities were estimated using a rigorous approach involving back calculation from the PFR raffinate inventory.

Chemical form of radionuclides:

H-3: -
C-14: -
Cl-36: -
Se-79: -
Tc-99: -
I-129: -
Ra: Trace quantities present.
Th: Trace quantities present.
U: Present as ammonium diuranate and UO₂.
Np: Trace quantities present.
Pu: Trace quantities present as PuO₂.

WASTE STREAM				5B22		ADU Floc			
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	= 7.52E-06	B B 1	= 7.52E-06	B B 2	Gd 153	= 4.60E-22	B B 2	= 4.60E-22	B B 2
Be 10	= 2.95E-13	B B 2	= 2.95E-13	B B 2	Ho 163	= 8.76E-14	B B 2	= 8.76E-14	B B 2
C 14	= 2.42E-08	B B 2	= 2.42E-08	B B 2	Ho 166m	= 9.28E-12	B B 2	= 9.28E-12	B B 2
Na 22					Tm 170				
Al 26					Tm 171	= 5.09E-13	B B 2	= 5.09E-13	B B 2
Cl 36	= 6.00E-13	B B 2	= 6.00E-13	B B 2	Lu 174	= 2.97E-13	B B 2	= 2.97E-13	B B 2
Ar 39					Lu 176				
Ar 42					Hf 178n	= 5.98E-11	B B 2	= 5.98E-11	B B 2
K 40	= 4.43E-14	B B 2	= 4.43E-14	B B 2	Hf 182				
Ca 41	= 4.98E-11	B B 2	= 4.98E-11	B B 2	Pt 193	= 5.48E-10	B B 2	= 5.48E-10	B B 2
Mn 53	< 3.80E-13	B C 3	= 3.80E-13	B C 2	Ti 204	= 1.12E-09	B B 2	= 1.12E-09	B B 2
Mn 54	< 7.10E-15	B C 3	= 7.10E-15	B C 2	Pb 205	= 2.19E-14	B B 2	= 2.19E-14	B B 2
Fe 55	= 1.03E-07	B C 3	= 1.03E-07	B C 2	Pb 210	= 1.63E-09	B B 2	= 1.63E-09	B B 2
Co 60	= 1.54E-06	B B 1	= 1.54E-06	B B 2	Bi 208	= 1.63E-14	B B 2	= 1.63E-14	B B 2
Ni 59	= 8.96E-08	B B 2	= 8.96E-08	B B 2	Bi 210m				
Ni 63	= 3.77E-06	B B 2	= 3.77E-06	B B 2	Po 210	= 1.50E-09	B B 2	= 1.50E-09	B B 2
Zn 65	= 1.55E-18	B B 2	= 1.55E-18	B B 2	Ra 223	= 1.99E-09	B B 2	= 1.99E-09	B B 2
Se 79	= 1.59E-07	B B 2	= 1.59E-07	B B 2	Ra 225	= 2.48E-08	B B 2	= 2.48E-08	B B 2
Kr 81					Ra 226	= 9.27E-09	B B 2	= 9.27E-09	B B 2
Kr 85					Ra 228	= 7.48E-14	B B 2	= 7.48E-14	B B 2
Rb 87	= 5.55E-12	B B 2	= 5.55E-12	B B 2	Ac 227	= 2.08E-09	B B 2	= 2.08E-09	B B 2
Sr 90	= 7.87E-03	B B 2	= 7.87E-03	B B 2	Th 227	= 1.99E-09	B B 2	= 1.99E-09	B B 2
Zr 93	= 5.96E-06	B B 2	= 5.96E-06	B B 2	Th 228	= 6.54E-05	B B 2	= 6.54E-05	B B 2
Nb 91	= 1.34E-08	B B 2	= 1.34E-08	B B 2	Th 229	= 2.48E-08	B B 2	= 2.48E-08	B B 2
Nb 92	= 4.40E-13	B B 2	= 4.40E-13	B B 2	Th 230	= 2.18E-06	B B 2	= 2.18E-06	B B 2
Nb 93m	= 9.88E-06	B B 2	= 9.88E-06	B B 2	Th 232	= 1.21E-13	B B 2	= 1.21E-13	B B 2
Nb 94	= 1.41E-07	B B 2	= 1.41E-07	B B 2	Th 234	= 1.54E-03	B B 2	= 1.54E-03	B B 2
Mo 93	= 5.22E-08	B B 2	= 5.22E-08	B B 2	Pa 231	= 2.46E-08	B B 2	= 2.46E-08	B B 2
Tc 97	= 8.54E-12	B B 2	= 8.54E-12	B B 2	Pa 233	= 2.47E-04	B B 2	= 2.47E-04	B B 2
Tc 99	= 1.25E-01	B B 2	= 1.25E-01	B B 2	U 232	= 6.37E-05	B B 2	= 6.37E-05	B B 2
Ru 106	< 3.54E-08	B C 2	= 3.54E-08	B C 2	U 233	= 1.34E-05	B B 2	= 1.34E-05	B B 2
Pd 107	= 2.74E-07	B B 2	= 2.74E-07	B B 2	U 234	= 1.22E-02	B B 1	= 1.22E-02	B B 2
Ag 108m	= 4.50E-10	B B 2	= 4.50E-10	B B 2	U 235	= 5.91E-05	B B 1	= 5.91E-05	B B 2
Ag 110m	= 7.09E-17	B B 2	= 7.09E-17	B B 2	U 236	= 1.25E-04	B B 1	= 1.25E-04	B B 2
Cd 109	= 3.73E-14	B B 2	= 3.73E-14	B B 2	U 238	= 1.54E-03	B B 1	= 1.54E-03	B B 2
Cd 113m	= 6.48E-07	B B 2	= 6.48E-07	B B 2	Np 237	= 2.47E-04	B B 2	= 2.47E-04	B B 2
Sn 119m	= 9.06E-17	B B 2	= 9.06E-17	B B 2	Pu 236	= 6.03E-10	B B 2	= 6.03E-10	B B 2
Sn 121m	= 1.96E-05	B B 2	= 1.96E-05	B B 2	Pu 238	= 2.05E+00	B B 2	= 2.05E+00	B B 2
Sn 123	= 1.66E-27	B B 2	= 1.66E-27	B B 2	Pu 239	= 1.55E-01	B B 2	= 1.55E-01	B B 2
Sn 126	= 5.49E-07	B B 2	= 5.49E-07	B B 2	Pu 240	= 1.57E-01	B B 2	= 1.57E-01	B B 2
Sb 125	= 2.93E-06	B B 2	= 2.93E-06	B B 2	Pu 241	= 1.42E+00	B B 1	= 1.42E+00	B B 2
Sb 126	= 5.49E-07	B B 2	= 5.49E-07	B B 2	Pu 242	= 1.26E-04	B B 1	= 1.26E-04	B B 2
Te 125m	< 6.93E-07	B C 3	= 6.93E-07	B C 2	Am 241	= 1.07E-01	B B 1	= 1.07E-01	B B 2
Te 127m					Am 242m	= 9.54E-05	B B 2	= 9.54E-05	B B 2
I 129	= 3.17E-04	B B 2	= 3.17E-04	B B 2	Am 243	= 6.38E-06	B B 2	= 6.38E-06	B B 2
Cs 134	= 2.39E-07	B C 3	= 2.39E-07	B B 2	Cm 242	= 7.96E-05	B B 2	= 7.96E-05	B B 2
Cs 135	= 7.68E-07	B B 2	= 7.68E-07	B B 2	Cm 243	= 1.66E-05	B B 1	= 1.66E-05	B B 2
Cs 137	= 2.30E-02	B B 2	= 2.30E-02	B B 2	Cm 244	= 1.33E-04	B B 2	= 1.33E-04	B B 2
Ba 133	= 2.36E-09	B B 2	= 2.36E-09	B B 2	Cm 245	= 1.73E-08	B B 2	= 1.73E-08	B B 2
La 137	= 5.55E-12	B B 2	= 5.55E-12	B B 2	Cm 246	= 6.81E-10	B B 2	= 6.81E-10	B B 2
La 138					Cm 248				
Ce 144	< 1.51E-12	B C 3	= 1.51E-12	B C 2	Cf 249	= 1.83E-14	B B 2	= 1.83E-14	B B 2
Pm 145	= 3.87E-11	B B 2	= 3.87E-11	B B 2	Cf 250	= 5.06E-15	B B 2	= 5.06E-15	B B 2
Pm 147	= 3.35E-05	B B 2	= 3.35E-05	B B 2	Cf 251				
Sm 147	= 4.11E-12	B B 2	= 4.11E-12	B B 2	Cf 252				
Sm 151	= 1.32E-03	B B 2	= 1.32E-03	B B 2	Unsp a				
Eu 152	= 6.95E-07	B B 2	= 6.95E-07	B B 2	Unsp b/g				
Eu 154	= 9.26E-03	B B 1	= 9.26E-03	B B 2	Total a	2.49E+00	*	2.49E+00	*
Eu 155	= 4.10E-03	B B 2	= 4.10E-03	B B 2	Total b/g	1.59E+00	*	1.59E+00	*

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