

WASTE STREAM	9B86/C	Sludge
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SITE Bradwell

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		= 0.5	7.9
Future arisings:				0.0
				0.0
Total future arisings:			0.0	0.0
Total waste volume:			0.5	7.9

Number of waste packages in stock: At 1.4.2025..... 6 packages

Comment on arising rates: -

Additional information on quantities: -

Uncertainty factors on volumes:

Stock (upper):	x 1.00	Arisings (upper):	x -
Stock (lower):	x 1.00	Arisings (lower):	x -

WASTE SOURCE The sludge originates from routine filtration of liquid effluents and cooling pond water and from special clean-up operations on cooling ponds.

PHYSICAL CHARACTERISTICS

General description: The waste consists of debris washed from persons, floors and clothing, corrosion products such as magnesium hydroxide and carbonate detached from fuel elements and materials such as flakes of paint. Also there is some oil and grease. Sludge particles may be up to millimetre size. Bulk sludge was retrieved from mules from where it was pumped to a buffer tank that was used to fill the three 400 litre barrels attached to the processing plant. These were filled in several stages with periods of in-vessel drying between fillings. This sequence was repeated until the packages were filled to the required level.

Changes since waste generated: -

Bulk density (t/m³): = 1.2

Comment on density: -

CHEMICAL COMPOSITION

General description and components (%wt): Siliceous materials (sand and cementitious particles), corrosion products (magnesium hydroxides, carbonate, iron oxy-hydroxides), ion exchange material and miscellaneous organic materials dominated by oil/paints.

Chemical state: Alkali

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	NE	-	
Other ferrous metals.....	NE	-	
Iron.....	= 5.5	-	
Aluminium.....	= 1.1	-	
Beryllium.....	TR	-	
Cobalt.....	= 0.01	-	
Copper.....	= 0.06	-	
Lead.....	TR	-	
Magnox/Magnesium.....	= 5.3	Unreacted Magnox is expected.	
Nickel.....	= 0.02	-	
Titanium.....	-	-	
Uranium.....	-	-	
Zinc.....	= 0.45	-	
Zircaloy/Zirconium.....	NE	-	
Other metals.....	= 1.6	0.04wt% chromium, 0.25wt% potassium, 0.05wt% manganese, 1.3wt% sodium.	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	NE	-	
Paper, cotton.....	NE	-	
Wood.....	= 0	-	
Halogenated plastics.....	= 0	-	
Total non-halogenated plastics.....	NE	-	
Condensation polymers.....	NE	-	
Others.....	= 0	-	
Organic ion exchange materials.....	NE	-	
Total rubber.....	= 0	-	
Halogenated rubber.....	= 0	-	
Non-halogenated rubber.....	= 0	-	
Hydrocarbons.....		-	
Oil or grease.....		-	
Fuel.....		-	
Asphalt/Tarmac (cont.coal tar).....		-	
Asphalt/Tarmac (no coal tar).....		-	
Bitumen.....		-	
Others.....	= 6.1	Organic carbon, of which 49.6wt% is hexane soluble oil.	
Other organics.....	NE	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 0	-	
Inorganic sludges and flocs.....	= 79.9	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	TR	-	
Cementitious material.....	NE	-	
Sand.....		-	
Glass/Ceramics.....	= 0	-	
Graphite.....	TR	-	
Desiccants/Catalysts.....		-	
Asbestos.....	= 0	-	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
Free aqueous liquids.....	P	-	
Free non-aqueous liquids.....	P	-	
Powder/Ash.....	= 0	-	

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	= 0	-
Chloride.....	= 0.28	-
Iodide.....	= 0	-
Cyanide.....	= 0	-
Carbonate.....	= 29.1	-
Nitrate.....	= 0	-
Nitrite.....	= 0	-
Phosphate.....	= 0	-
Sulphate.....	= 0	-
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.....	= 0	-
Hydrides.....	= 0	-
Biological etc. materials.....	TR	-
Biodegradable materials.....	0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....		-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	NE	-
Reacting with water.....		-
Higher activity particles.....		-
Soluble solids as bulk chemical compounds.....		-

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	0	-
Benzene.....		-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....		-
Phenol.....		-
Styrene.....		-
Tri-butyl phosphate.....		-
Other organophosphates.....		-
Vinyl chloride.....		-
Arsenic.....		-
Barium.....		-
Boron.....		-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	= 0.04	-
Caesium.....		-
Selenium.....		-
Chromium.....		-
Molybdenum.....		-
Thallium.....		-
Tin.....		-
Vanadium.....		-
Mercury compounds.....		-
Others.....		-

Complexing agents (%wt):

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

Physical components:

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

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		

Comments on planned treatments:

-

Conditioning method:

Conditioning has taken place using the FAVORIT conditioning plant.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

-

Further information on the conditioning matrix:

-

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	500 l RS drum (0mm Pb)	100.0	0.08	0.08	6	-

Range in container waste loading: -

Other information on packaging and conditioning: -

Conditioned density (t/m³): ~ 1.2

Conditioned density comment: -

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: Contaminated sludge. Contamination by fission products, actinides and activation products.

Uncertainty: Specific activity is a function of Station operating history. The values quoted are indicative of the activities that might be expected.

Measurement of radioactivities: Specific activities were calculated using mass of waste, density of waste, and fingerprints obtained from 2013 characterisation.

Chemical form of radionuclides:

H-3: Most tritium is expected to be present as water but some may be present in the form of other inorganic compounds or as organic compounds.

C-14: Carbon 14 may be present as graphite.

Cl-36: The chemical form of chlorine 36 has not been assessed.

Se-79: The chemical form of selenium has not been determined.

Tc-99: The chemical form of technetium has not been determined.

I-129: -

Ra: -

Th: -

U: The chemical form of uranium isotopes has not been determined but uranium oxides are present as corrosion products.

Np: The chemical form of neptunium has not been determined.

Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

WASTE STREAM		9B86/C		Sludge					
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	2.14E-03	B B 2			Gd 153		8		
Be 10	1.37E-07	B B 2			Ho 163	1.41E-05	B B 2		
C 14	7.79E-04	B B 2			Ho 166m	1.48E-05	B B 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	1.97E-06	B B 2			Lu 174		8		
Ar 39	7.63E-04	B B 2			Lu 176		8		
Ar 42	1.62E-09	B B 2			Hf 178n	1.93E-05	B B 2		
K 40	4.56E-09	B B 2			Hf 182		8		
Ca 41	2.02E-05	B B 2			Pt 193	1.72E-07	B B 2		
Mn 53		8			Tl 204	4.60E-07	B B 2		
Mn 54		8			Pb 205		8		
Fe 55	1.77E-03	B B 2			Pb 210		8		
Co 60	4.42E-03	B B 2			Bi 208		8		
Ni 59	2.02E-05	B B 2			Bi 210m		8		
Ni 63	1.52E-04	B B 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	4.72E-08	B B 2			Ra 225		8		
Kr 81	5.00E-09	B B 2			Ra 226		8		
Kr 85	8.73E-04	B B 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	1.38E-02	B B 2			Th 227		8		
Zr 93	2.02E-06	B B 2			Th 228	6.66E-08	B B 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	1.34E-08	B B 2		
Nb 93m	4.76E-06	B B 2			Th 232		8		
Nb 94	4.29E-05	B B 2			Th 234	1.80E-05	B B 2		
Mo 93	1.01E-05	B B 2			Pa 231	1.62E-09	B B 2		
Tc 97		8			Pa 233	1.92E-06	B B 2		
Tc 99	1.31E-05	B B 2			U 232	6.47E-08	B B 2		
Ru 106		8			U 233	1.53E-07	B B 2		
Pd 107	9.16E-08	B B 2			U 234	2.39E-05	B B 2		
Ag 108m	4.90E-08	B B 2			U 235	9.89E-07	B B 2		
Ag 110m		8			U 236	3.66E-06	B B 2		
Cd 109		8			U 238	1.80E-05	B B 2		
Cd 113m	1.86E-07	B B 2			Np 237	1.92E-06	B B 2		
Sn 119m		8			Pu 236		8		
Sn 121m	5.55E-03	B B 2			Pu 238	8.07E-03	B B 2		
Sn 123		8			Pu 239	1.39E-02	B B 2		
Sn 126	1.99E-07	B B 2			Pu 240	1.38E-02	B B 2		
Sb 125		8			Pu 241	1.34E-01	B B 2		
Sb 126	2.79E-08	B B 2			Pu 242	3.59E-06	B B 2		
Te 125m		8			Am 241	6.25E-02	B B 2		
Te 127m		8			Am 242m	3.85E-05	B B 2		
I 129	2.38E-08	B B 2			Am 243	1.24E-05	B B 2		
Cs 134	3.48E-06	B B 2			Cm 242	3.18E-05	B B 2		
Cs 135	1.37E-08	B B 2			Cm 243	4.54E-06	B B 2		
Cs 137	5.18E-02	B B 2			Cm 244	5.34E-05	B B 2		
Ba 133	2.91E-05	B B 2			Cm 245	5.27E-09	B B 2		
La 137	1.42E-09	B B 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	1.91E-05	B B 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	8.98E-04	B B 2			Unsp a				
Eu 152	9.95E-07	B B 2			Unsp b/g				
Eu 154	8.09E-04	B B 2			Total a	9.84E-02	*	0	*
Eu 155	1.15E-04	B B 2			Total b/g	2.18E-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