

WASTE STREAM	9A03/C	Ion Exchange Material
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SITE Berkeley

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		= 11.1	38.1
Future arisings:				0.0
Total future arisings:			0.0	0.0
Total waste volume:			11.1	38.1

Number of waste packages in stock: At 1.4.2025..... 7 packages

Comment on arising rates: -

Additional information on quantities: Waste conditioned in 2016

Uncertainty factors on volumes: Stock (upper): x 1.00 Arisings (upper): x -
Stock (lower): x 1.00 Arisings (lower): x -

WASTE SOURCE Spent ion exchange materials arising from the treatment of pond waters.

PHYSICAL CHARACTERISTICS

General description: The waste in the tank was easily pumped and had rapid settling characteristics. There are no large items that may require special handling.

Changes since waste generated: -

Bulk density (t/m³): = 0.88

Comment on density: Density of dry resin.

CHEMICAL COMPOSITION

General description and components (%wt): Composition appropriate to proprietary ion exchange materials, some of which are organic in nature. Water in which some of the material is immersed. Proprietary ion exchange materials: Lewatit DN (phenol formaldehyde) and similar Amberlite IRN74 resin (phenol formaldehyde). About 30% wt will probably be absorbed water. Charge records indicate which IEX material was used.

Chemical state: Alkali

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	-	
Iron.....	-	-	
Aluminium.....	= 0	-	
Beryllium.....	< 0.01	-	
Cobalt.....	-	-	
Copper.....	= 0	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	-	-	
Titanium.....	-	-	
Uranium.....	-	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	= 0	No "other" metals present.	

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.....	~ 41.9	Lewatit DN (38.7% vol) and Duolite C3 (3.2% vol)	
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.....	-	-	
Other organics.....	= 0	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 58.1	Synthetic zeolite: AW 500 (1.6% vol), Duocil (22% vol), Decalso Y (32.8% vol). Natural zeolite: Attapulugus clay (1.6% vol).	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	= 0	-	
Sand.....	-	-	
Glass/Ceramics.....	= 0	-	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	-	-	
Asbestos.....	= 0	-	
Non/low friable.....	-	-	
Moderately friable.....	-	-	
Highly friable.....	-	-	
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.....	NE	-
Chloride.....	= 0.02	-
Iodide.....	NE	-
Cyanide.....	NE	-
Carbonate.....	= 1.7	-
Nitrate.....	NE	-
Nitrite.....	NE	-
Phosphate.....	NE	-
Sulphate.....	< 0.80	-
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.....	= 0.10	-
Hydrides.....	= 0	-
Biological etc. materials.....	= 0	-
Biodegradable materials.....	0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....	-	-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	= 0	-
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.....		-
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:

FAVORIT was used to condition waste, conditioned using heated vacuum drying.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

-

Further information on the conditioning matrix:

Vacuum dried.

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	3 m³ RS box	100.0	1.6	1.6	7	-

Range in container waste loading: No significant variability is expected.

Other information on packaging and conditioning: -

Conditioned density (t/m³): 0.88

Conditioned density comment: Density given is the average from all package records.

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: Spent ion exchange materials arisings from the treatment of pond waters. There is expected to be contamination by fission products and activation products including actinides. Caesium-137 is expected to be a dominant nuclide.

Uncertainty: Specific activity is a function of station operating history. The values quoted are based on original characterisation data, scaled to Cs-137 content of each waste package and summed to output waste stream total, then decayed to 2025.

Measurement of radioactivities: Values were derived by extrapolation from available data.

Chemical form of radionuclides: H-3: Most tritium is expected to be present as water but some may be in the form of other inorganic compounds or as organic compounds.
C-14: Carbon 14 will probably be present as graphite.
Cl-36: Chlorine 36 will probably be present as inorganic chloride.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
I-129: -
Ra: The radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: The chemical form of uranium isotopes has not been determined but may be oxides.
Np: The neptunium content is insignificant.
Pu: The chemical form of plutonium isotopes has not been determined but may be oxides.

WASTE STREAM			9A03/C		Ion Exchange Material				
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	8.79E-06	C C 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	3.73E-07	C C 2			Ho 166m	1.70E-05	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	3.49E-09	C C 2			Lu 174		8		
Ar 39	1.06E-07	C C 2			Lu 176		8		
Ar 42		8			Hf 178n	1.93E-05	C C 2		
K 40		8			Hf 182		8		
Ca 41	2.15E-09	C C 2			Pt 193	1.31E-07	C C 2		
Mn 53		8			Tl 204	1.75E-07	C C 2		
Mn 54		8			Pb 205		8		
Fe 55	1.68E-07	C C 2			Pb 210		8		
Co 60	1.16E-06	C C 2			Bi 208		8		
Ni 59	5.22E-09	C C 2			Bi 210m		8		
Ni 63	1.55E-04	C C 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	5.78E-08	C C 2			Ra 225		8		
Kr 81	4.84E-09	C C 2			Ra 226		8		
Kr 85	6.85E-04	C C 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	3.74E-02	C C 2			Th 227		8		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	1.71E-08	C C 2			Th 232		8		
Nb 94	5.52E-09	C C 2			Th 234	4.80E-07	C C 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	2.18E-08	C C 2		
Tc 99	2.65E-04	C C 2			U 232		8		
Ru 106		8			U 233	1.89E-09	C C 2		
Pd 107	1.41E-07	C C 2			U 234	4.28E-07	C C 2		
Ag 108m	4.33E-09	C C 2			U 235	1.24E-08	C C 2		
Ag 110m		8			U 236	4.59E-08	C C 2		
Cd 109		8			U 238	4.80E-07	C C 2		
Cd 113m	2.91E-06	C C 2			Np 237	2.18E-08	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	4.59E-05	C C 2		
Sn 123		8			Pu 239	1.10E-04	C C 2		
Sn 126	5.25E-07	C C 2			Pu 240	1.09E-04	C C 2		
Sb 125	7.91E-08	C C 2			Pu 241	1.19E-03	C C 2		
Sb 126	7.35E-08	C C 2			Pu 242	8.28E-08	C C 2		
Te 125m	1.98E-08	C C 2			Am 241	1.73E-04	C C 2		
Te 127m		8			Am 242m	4.70E-07	C C 2		
I 129	4.92E-07	C C 2			Am 243	1.55E-07	C C 2		
Cs 134	2.52E-07	C C 2			Cm 242	3.88E-07	C C 2		
Cs 135	1.05E-06	C C 2			Cm 243	4.96E-08	C C 2		
Cs 137	6.62E-01	C C 1			Cm 244	5.34E-07	C C 2		
Ba 133	6.97E-09	C C 2			Cm 245		8		
La 137	1.60E-09	C C 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	9.19E-09	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.83E-05	C C 2			Unsp a				
Eu 152		8			Unsp b/g				
Eu 154	5.74E-08	C C 2			Total a	4.40E-04	*	0	*
Eu 155		8			Total b/g	7.02E-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