

WASTE STREAM	9A25	Ion Exchange Material in Drums
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SITE Berkeley

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	At 1.4.2025	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:		= 5.6			
Future arisings:					
Total future arisings:		0.0			
Total waste volume:		5.6			

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

Comment on arising rates: -

Additional information on quantities: Station operation ceased in March 1989. Accumulation of this type of waste in drums ceased in June 1980. The volume of the waste was re-assessed prior to the 2004 Inventory.

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

WASTE SOURCE Spent ion exchange materials arising from the treatment of pond waters. The material was packaged in modified '45 gallon' mild steel drums. One of the drums is reported as being a dummy unit containing sand/gravel.

PHYSICAL CHARACTERISTICS

General description: The waste arose from an early method of controlling the caesium levels in the BPS fuel ponds. Drums containing ion exchange materials were submerged in the ponds and the pond water was pumped through the ion exchanger. The materials (Duocil, Decalso Y and Lewatit DN) were granular when they were loaded into the drums. The drums were drained before being placed in the vaults. The empty drums are included in the waste stream 9A917, but will be processed with the Miscellaneous Contaminated Items streams (9A36, 9A37 and 9A38). There are no large items that may require special handling.

Changes since waste generated: -

Bulk density (t/m³): ~ 1.0

Comment on density: The assumption of 1 t/m³ as the average bulk density may be subject to revision.

CHEMICAL COMPOSITION

General description and components (%wt): Some drums contain alumino-silicate, an inorganic ion exchange material, known as Duocil and Decalso Y. Some drums contain phenol formaldehyde, an organic ion exchange material, known as Lewatit DN and Amberlite Y. Drums may contain sand or gravel.

Chemical state: Alkali

Sheet metal proportion / thickness: No sheet or bulk metal items present.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	NE	There may be small contamination (<1% wt) by stainless and mild steel. The drum is not included in this waste stream.	
Other ferrous metals.....	NE	There may be small contamination (<1% wt) by stainless and mild steel. The drum is not included in this waste stream.	
Iron.....	-	-	
Aluminium.....	= 0	-	
Beryllium.....	< 0.01	-	
Cobalt.....	-	-	
Copper.....	= 0	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	TR	-	
Nickel.....	-	-	
Titanium.....	-	-	
Uranium.....	-	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	TR	-	
Other metals.....	= 0	No "other" metals present.	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 0	-	
Paper, cotton.....	= 0	-	
Wood.....	= 0	-	
Halogenated plastics.....	= 0	-	
Total non-halogenated plastics.....	= 0	-	
Condensation polymers.....	= 0	-	
Others.....	= 0	-	
Organic ion exchange materials.....	~ 45.0	-	
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.....	~ 53.0	-	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	< 1.3	-	
Cementitious material.....	= 0	-	
Sand.....	< 1.3	-	
Glass/Ceramics.....	= 0	-	
Graphite.....	TR	-	
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.....	<< 0.01	-
Chloride.....	< 0.01	-
Iodide.....	<< 0.01	-
Cyanide.....	= 0	-
Carbonate.....	~ 2.0	-
Nitrate.....	NE	-
Nitrite.....	NE	-
Phosphate.....	NE	-
Sulphate.....	< 0.01	-
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.....	-	-
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.....	TR	-

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	On-site	100.0

Comments on planned treatments:

-

Conditioning method:

This stream will be co-packaged with 9A31, 9A39, 9A47, 9A52, 9A60 and 9A66 in Type VI DCIC containers. Remainder of vault 1 waste streams will be co-packaged together in Concrete boxes (9A61, 9A62, 9A67, 9A32, 9A40, 9A48, 9A53, 9A73) Packages for vault 1 are assigned to 9A25, 9A32 & 9A73.

Conditioning plants:

Plant Name	Location
BRK AVDS	Berkeley

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
3 m³ RS box	100.0	1.2	2.5	5	-

Range in container waste loading: -

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

-

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: Spent ion exchange materials arising from the treatment of pond water. 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 indicative of the activities that are expected.

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 probably will be uranium oxides.

Np: The neptunium content is insignificant.
Pu: The chemical form of plutonium isotopes has not been determined but probably will be plutonium oxides.

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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	7.29E-06	C C 2			Gd 153		8		
Be 10					Ho 163		8		
C 14	9.99E-08	C C 2			Ho 166m		8		
Na 22					Tm 170		8		
Al 26					Tm 171		8		
Cl 36	7.00E-09	C C 2			Lu 174		8		
Ar 39					Lu 176		8		
Ar 42					Hf 178n		8		
K 40					Hf 182		8		
Ca 41					Pt 193		8		
Mn 53					Tl 204		8		
Mn 54					Pb 205		8		
Fe 55	9.22E-09	C C 2			Pb 210		8		
Co 60	2.81E-07	C C 2			Bi 208		8		
Ni 59	3.00E-08	C C 2			Bi 210m		8		
Ni 63	6.18E-06	C C 2			Po 210		8		
Zn 65					Ra 223		8		
Se 79	1.72E-07	C C 2			Ra 225		8		
Kr 81					Ra 226		8		
Kr 85					Ra 228		8		
Rb 87					Ac 227		8		
Sr 90	1.30E-01	C C 2			Th 227		8		
Zr 93	1.00E-05	C C 2			Th 228		8		
Nb 91					Th 229		8		
Nb 92					Th 230		8		
Nb 93m	6.66E-06	C C 2			Th 232		8		
Nb 94	5.00E-09	C C 2			Th 234	8.00E-07	C C 2		
Mo 93					Pa 231		8		
Tc 97					Pa 233	9.31E-08	C C 2		
Tc 99	6.00E-05	C C 2			U 232		8		
Ru 106					U 233		8		
Pd 107					U 234	6.05E-07	C C 2		
Ag 108m	< 2.93E-08	C 3			U 235	2.00E-08	C C 2		
Ag 110m					U 236	9.01E-08	C C 2		
Cd 109					U 238	8.00E-07	C C 2		
Cd 113m					Np 237	9.31E-08	C C 2		
Sn 119m					Pu 236		8		
Sn 121m					Pu 238	6.96E-05	C C 2		
Sn 123					Pu 239	3.00E-04	C C 2		
Sn 126	1.30E-06	C C 2			Pu 240	2.00E-04	C C 2		
Sb 125	5.35E-07	C C 2			Pu 241	1.27E-03	C C 2		
Sb 126	1.82E-07	C C 2			Pu 242	2.00E-07	C C 2		
Te 125m	1.34E-07	C C 2			Am 241	5.43E-04	C C 2		
Te 127m					Am 242m	1.83E-06	C C 2		
I 129	1.00E-07	C C 2			Am 243	6.99E-07	C C 2		
Cs 134	7.07E-08	C C 2			Cm 242	1.51E-06	C C 2		
Cs 135	3.00E-05	C C 2			Cm 243	3.31E-07	C C 2		
Cs 137	1.98E+00	C C 2			Cm 244	2.01E-07	C C 2		
Ba 133					Cm 245		8		
La 137					Cm 246		8		
La 138					Cm 248		8		
Ce 144					Cf 249		8		
Pm 145					Cf 250		8		
Pm 147	7.72E-07	C C 2			Cf 251		8		
Sm 147					Cf 252		8		
Sm 151	4.35E-04	C C 2			Unsp a				
Eu 152					Unsp b/g				
Eu 154	1.18E-05	C C 2			Total a	1.12E-03	*	0	*
Eu 155	7.76E-07	C C 2			Total b/g	2.11E+00	*	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