WASTE STREAM	9B02/C	Ion Exchange Material

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		= 16.4	54.0
Future arisings:				0.0
				0.0
Total future arisings:			**0.0**	**0.0**
Total waste volume:			**16.4**	**54.0**

Number of waste packages in stock: At 1.4.2025…… 41 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 Pond water treatment plant. Pre-treatment cation (predominantly Caesium) exchange unit.

PHYSICAL CHARACTERISTICS

General description: Waste consists of spent ion exchange (IX) material from the treatment of pond waters. This includes natural zeolite (Attapulgus clay) and synthetic zeolites (AW 500, Duocil and Decalso Y), as well as organic (phenol formaldehyde-based cation resins (Lewatit DN and Duolite C3). Ion exchange resins are dried, prior to packaging, to remove all interstitial water.

Changes since waste generated: -

Bulk density (t/m³): ~ 0.70

Comment on density: The bulk density of the dried waste ranges from 0.36 to 0.90 (t/m3). The mean wet (drained) density is 1.2t/m3. The bulk density was obtained by dividing total wastestream mass by the total wastestream volume.

CHEMICAL COMPOSITION

General description and components (%wt): Ion exchange materials that have been used include: Lewatit DN Bead (organic), Decalso Y Synthetic Zeolite (inorganic), Decalso Duocil (inorganic), Duolite C3 (organic), AW 500 Synthetic Zeolite (inorganic) and Attapulgas Clay (inorganic).

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……		-	
Iron……		-	
Aluminium……		-	
Beryllium……	TR	-	
Cobalt……		-	
Copper……	NE	-	
Lead……	TR	-	
Magnox/Magnesium……	TR	-	
Nickel……		-	
Titanium……		-	
Uranium……	NE	-	
Zinc……	NE	-	
Zircaloy/Zirconium……	NE	-	
Other metals……	NE	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	= 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 Bead (organic, 39 wt%) and Duolite C3 (organic, 3 wt%) - (of which 27.3% is water chemically bound to the resin)	
Total rubber	= 0	-	
Halogenated rubber	= 0	-	
Non-halogenated rubber	= 0	-	
Hydrocarbons		-	
Oil or grease	= 0	-	
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	Decalso Y Synthetic Zeolite (inorganic, 33 wt%), Decalso Duocil (inorganic, 22 wt%), AW 500 Synthetic Zeolite (inorganic, 2 wt%) and Attapulgas Clay (inorganic, 2 wt%). - (of which 37.8% is water chemically bound to the resin)	
Inorganic sludges and flocs	NE	-	
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	NE	-
Iodide	NE	-
Cyanide	= 0	-
Carbonate		-
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	TR	-
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	TR	-
Higher activity particles		-
Soluble solids as bulk chemical compounds		-

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide		-
Benzene		-
Chlorinated solvents		-
Formaldehyde		-
Organometallics		-
Phenol		-
Styrene		-
Tri-butyl phosphate		-
Other organophosphates		-
Vinyl chloride		-
Arsenic		-
Barium		-
Boron	0	-
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		-
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		

Comments on planned treatments: -

Conditioning method: All of the waste has been retrieved, conditioned and packaged The waste has undergone thermal vacuum drying and emplacement in DCICs with no further conditioning.

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 (m^3)	Payload (m^3)	Number of packages	Estimated start date for packaging
500 l RS drum (0mm Pb)	100.0	0.40	0.40	41	-

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

Other information on packaging and conditioning: -

Conditioned density (t/m^3): ~ 0.70
Conditioned density comment: The bulk density of the dried waste ranges from 0.36 to 0.90 (t/m3)

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)			
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	100.0		
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 from the treatment of pond water to remove soluble cationic species, Predominantly caesium-137. Contamination by fission products, actinides and activation products.

Uncertainty: The values for the radionuclides are taken from characterisation data based on sampling and analysis and as such are accurate to within sampling errors.

Measurement of radioactivities: Values were determined from sampling and characterisation data, using Cs-137 scaled fingerprint and ISOCS measured Cs-137 to generate specific activity for each package.

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 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 assessed.
Np: The chemical form of neptunium has not been determined.
Pu: The chemical form of plutonium isotopes has not been assessed.

WASTE STREAM **9B02/C** **Ion Exchange Material**

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	2.57E-05	C C 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	1.30E-07	C C 2			Ho 166m	4.83E-06	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	2.72E-09	C C 2			Lu 174		8		
Ar 39	4.86E-06	C C 2			Lu 176		8		
Ar 42		8			Hf 178n	4.62E-06	C C 2		
K 40		8			Hf 182		8		
Ca 41	9.24E-08	C C 2			Pt 193	2.23E-06	C C 2		
Mn 53		8			Tl 204	1.16E-08	C C 2		
Mn 54		8			Pb 205		8		
Fe 55	1.21E-07	C C 2			Pb 210		8		
Co 60	1.89E-05	C C 2			Bi 208		8		
Ni 59	2.04E-07	C C 2			Bi 210m		8		
Ni 63	2.22E-06	C C 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1.66E-08	C C 2			Ra 225		8		
Kr 81	1.39E-09	C C 2			Ra 226		8		
Kr 85	1.17E-04	C C 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	3.31E-01	C C 2			Th 227		8		
Zr 93		8			Th 228	1.80E-09	C C 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	5.65E-07	C C 2			Th 232		8		
Nb 94	2.58E-07	C C 2			Th 234	1.20E-06	C C 2		
Mo 93	2.96E-09	C C 2			Pa 231		8		
Tc 97		8			Pa 233	6.18E-08	C C 2		
Tc 99	6.63E-06	C C 2			U 232	1.75E-09	C C 2		
Ru 106		8			U 233	4.72E-09	C C 2		
Pd 107	4.04E-08	C C 2			U 234	3.06E-07	C C 2		
Ag 108m	2.00E-07	C C 2			U 235	3.11E-08	C C 2		
Ag 110m		8			U 236	1.15E-07	C C 2		
Cd 109		8			U 238	1.20E-06	C C 2		
Cd 113m	5.56E-07	C C 2			Np 237	6.18E-08	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	1.68E-08	C C 2			Pu 238	1.07E-04	C C 2		
Sn 123		8			Pu 239	1.76E-04	C C 2		
Sn 126	1.50E-07	C C 2			Pu 240	1.75E-04	C C 2		
Sb 125	3.03E-09	C C 2			Pu 241	1.96E-03	C C 2		
Sb 126	2.10E-08	C C 2			Pu 242	2.07E-07	C C 2		
Te 125m		8			Am 241	5.86E-04	C C 2		
Te 127m		8			Am 242m	1.13E-06	C C 2		
I 129	1.40E-08	C C 2			Am 243	3.88E-07	C C 2		
Cs 134	8.59E-05	C C 2			Cm 242	9.34E-07	C C 2		
Cs 135	6.96E-05	C C 2			Cm 243	2.05E-07	C C 2		
Cs 137	2.87E+00	C C 2			Cm 244	2.99E-06	C C 2		
Ba 133	3.00E-08	C C 2			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	8.96E-06	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	4.01E-05	C C 2			Unsp a				
Eu 152	1.49E-08	C C 2			Unsp b/g				
Eu 154	2.34E-06	C C 2			**Total a**	**1.05E-03**	*	**0**	*
Eu 155	2.68E-07	C C 2			**Total b/g**	**3.20E+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