

<b>WASTE STREAM</b>	<b>9C36/C</b>	<b>Ion Exchange Resin from Ponds</b>
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**SITE** Bradwell

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** ILW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	18.2m <sup>3</sup>	66.6m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>	0 m <sup>3</sup>
Total waste volume:		18.2m <sup>3</sup>	66.6m <sup>3</sup>
Number of waste packages in stock:	At 1.4.2022.....	51 package(s)	

Comment on volumes: -

Uncertainty factors on volumes:	Stock (upper):	x 1.2	Arisings (upper)	x
	Stock (lower):	x 0.8	Arisings (lower)	x

**WASTE SOURCE** Pond water treatment plant caesium removal units.

**PHYSICAL CHARACTERISTICS**

General description: Spent caesium-selective ion exchange material arising from the treatment of pond waters in the Pond Water Filtration and Caesium Removal (PWFCR) plant. Conditioned, by drying, through the use of the advanced drying vacuum system (AVDS).

Physical components (%vol): Ion exchange material (100%). Some water still bound to resin.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): 1.17

Comment on density: The density is the wasteform density reported in the assessment report for the final Letter of Compliance submission, NXA/27371670 Issue 1.

**CHEMICAL COMPOSITION**

General description and components (%wt): Composition appropriate to proprietary ion exchange materials, some of which are organic in nature. Water in which the ion exchange material is immersed. Proprietary ion exchange materials, Duolite ARC 9359 (100 wt%).

Chemical state: -

Chemical form of radionuclides:

- H-3: The chemical form of tritium has not been determined.
- C-14: The chemical form of carbon 14 has not been determined but may be graphite.
- Cl-36: The chemical form of chlorine 36 has not been determined but may be chloride.
- Se-79: The chemical form of selenium has not been determined.
- Tc-99: The chemical form of technetium has not been determined.
- U: The chemical form of uranium isotopes is not determined but may be uranium oxides.
- Np: The chemical form of neptunium has not been determined.
- Pu: The chemical form of plutonium isotopes is not determined but may be plutonium oxides.

Metals and alloys (%wt): There are no sheet or bulk metal items.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....	NE		
Iron.....			
Aluminium.....	NE		
Beryllium.....	TR		
Cobalt.....			

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---------------------	---------------	--------------------------------------

Copper.....	NE	
Lead.....	TR	Lead would be in trace quantities, if present.
Magnox/Magnesium.....	NE	
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....	NE	
Zircaloy/Zirconium.....	NE	
Other metals.....	NE	"Other" metals have not been assessed.

Organics (%wt):                      Ion exchange resins: Duolite (phenol formaldehyde). There are no halogenated plastics or rubbers present.

	(%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....	~100.0	Duolite ARC 9359	
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.....	NE		

Other materials (%wt):                      -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	NE		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	0		

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Desiccants/Catalysts.....	
Asbestos.....	0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt):      Not fully assessed.

	(%wt)	Type(s) and comment
Fluoride.....	NE	
Chloride.....	NE	
Iodide.....	NE	
Cyanide.....	0	
Carbonate.....	NE	
Nitrate.....	NE	
Nitrite.....	NE	
Phosphate.....	NE	
Sulphate.....	NE	
Sulphide.....	NE	

Materials of interest for waste acceptance criteria:      No materials likely to pose a fire or other non-radiological hazard have been identified.

	(%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.....		

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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.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		
EEE Type 2.....		
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		

Complexing agents (%wt): Yes

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

**WASTE STREAM****9C36/C****Ion Exchange Resin from Ponds**

Potential for the waste to contain discrete items:

No. In & of itself not a DI; assumed not likely to contain any "rogue" items that could be.

**PACKAGING AND CONDITIONING**

Container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	500 l RS drum (0mm Pb)	100.0	0.36	0.36	51

Container type comment: MOSAIKs are T-ISAR and M II-15 EI.

Range in container waste volume: -

Other information on containers: -

Conditioned density (t/m<sup>3</sup>): 1.17

Conditioned density comment: The density is the wasteform density reported in the assessment report for the final Letter of Compliance submission, NXA/27371670 Issue 1.

Other information on conditioning: -

**RADIOACTIVITY**

Source: Spent ion exchange resins arising from the treatment of pond water. Resins are used to remove caesium from fuel pond water. There will be contamination by other fission products, actinides and activation products.

Uncertainty: -

Definition of total alpha and total beta/gamma: Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.

Measurement of radioactivities: Specific activity is a function of Station operating history. The values are calculated using the ST4 RN inventory (WD/CALC/1554 Issue 2) and the wastestream volume.

Other information: -

**WASTE STREAM**

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**Ion Exchange Resin from Ponds**

Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	2.68E-05	CC 2			Gd 153		8		
Be 10		CC 2			Ho 163	1.78E-08	CC 2		
C 14	2.36E-06	CC 2			Ho 166m	5.48E-06	CC 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	3.09E-07	CC 2		
Cl 36	4.23E-09	CC 2			Lu 174	8.33E-09	8		
Ar 39	7.34E-07	8			Lu 176		8		
Ar 42		8			Hf 178n	1.15E-05	8		
K 40		8			Hf 182		8		
Ca 41	1.86E-08	CC 2			Pt 193	8.88E-08	8		
Mn 53		8			Tl 204	9.44E-06	CC 2		
Mn 54		CC 2			Pb 205		8		
Fe 55	4.95E-06	CC 2			Pb 210		CC 2		
Co 60	8.58E-05	CC 2			Bi 208		CC 2		
Ni 59	6.36E-07	CC 2			Bi 210m		CC 2		
Ni 63	9.86E-04	CC 2			Po 210		CC 2		
Zn 65		CC 2			Ra 223		8		
Se 79	1.84E-08	CC 2			Ra 225		CC 2		
Kr 81	1.81E-09	8			Ra 226		CC 2		
Kr 85	1.33E-03	CC 2			Ra 228		8		
Rb 87		8			Ac 227		CC 2		
Sr 90	7.45E-02	CC 2			Th 227		8		
Zr 93	9.04E-07	CC 2			Th 228	2.87E-09	CC 2		
Nb 91		8			Th 229		CC 2		
Nb 92		8			Th 230		CC 2		
Nb 93m	2.73E-06	CC 2			Th 232		CC 2		
Nb 94	2.13E-07	CC 2			Th 234	1.33E-06	CC 2		
Mo 93	1.26E-08	CC 2			Pa 231		8		
Tc 97		8			Pa 233	5.33E-08	8		
Tc 99	7.36E-06	CC 2			U 232	2.8E-09	CC 2		
Ru 106	1E-07	CC 2			U 233	5.3E-09	CC 2		
Pd 107	4.49E-08	CC 2			U 234	9.51E-07	CC 2		
Ag 108m	8.82E-08	CC 2			U 235	3.45E-08	CC 2		
Ag 110m		CC 2			U 236	1.27E-07	CC 2		
Cd 109		CC 2			U 238	1.33E-06	CC 2		
Cd 113m	3.81E-06	CC 2			Np 237	5.33E-08	CC 2		
Sn 119m		8			Pu 236		CC 2		
Sn 121m	9.22E-06	CC 2			Pu 238	1.58E-04	CC 2		
Sn 123		8			Pu 239	1.31E-04	CC 2		
Sn 126	1.67E-07	CC 2			Pu 240	1.3E-04	CC 2		
Sb 125	2.85E-05	CC 2			Pu 241	6.13E-03	CC 2		
Sb 126	2.34E-08	CC 2			Pu 242	2.3E-07	CC 2		
Te 125m	7.14E-06	CC 2			Am 241	3.53E-04	CC 2		
Te 127m		8			Am 242m	1.5E-06	CC 2		
I 129	1.56E-08	CC 2			Am 243	4.32E-07	CC 2		
Cs 134	3.27E-05	CC 2			Cm 242	1.23E-06	CC 2		
Cs 135	3.35E-07	CC 2			Cm 243	2.63E-07	CC 2		
Cs 137	1.84E+00	CC 2			Cm 244	4.31E-06	CC 2		
Ba 133	3.7E-07	CC 2			Cm 245		CC 2		
La 137		CC 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	3.63E-09	CC 2			Cf 249		8		
Pm 145		CC 2			Cf 250		8		
Pm 147	1.29E-05	CC 2			Cf 251		8		
Sm 147		CC 2			Cf 252		8		
Sm 151	2.09E-04	CC 2			Other a				
Eu 152	4.69E-07	CC 2			Other b/g		CC 2		
Eu 154	2.03E-04	CC 2			<b>Total a</b>	<b>7.81E-04</b>	<b>CC 2</b>	<b>0</b>	
Eu 155	5.12E-05	CC 2			<b>Total b/g</b>	<b>1.92E+00</b>	<b>CC 2</b>	<b>0</b>	

**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 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