

WASTE STREAM	3S12/C	CVCS Resins and Spent Resins (ILW) - Conditioned waste
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SITE Sizewell B

SITE OWNER EDFE NGL

WASTE CUSTODIAN EDFE NGL

WASTE TYPE ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	26.0 m ³	72.6 m ³
Future arisings -	1.4.2019 - 31.3.2025.....	0 m ³	0 m ³
	1.4.2026 - 31.3.2027.....	~26.0 m ³	72.6 m ³
	1.4.2028 - 31.3.2041.....	0 m ³	0 m ³
	1.4.2041 - 31.3.2042.....	~23.2 m ³	64.7 m ³
Total future arisings:		49.1 m ³	137.3 m ³
Total waste volume:		75.1 m ³	209.9 m ³
Number of waste packages in stock:	At 1.4.2019.....	55 package(s)	

Comment on volumes: Volumes are for conditioned waste. Waste arisings dependant on station operations and on planned conditioning campaigns. Campaign 2 (~2026/7) will process ~25m³ of waste and Campaign 3 (~2041) will process ~20.5m³ of waste. ~25m³ of waste in 55 'MOSAIK' casks of total volume 72.6m³.

Uncertainty factors on volumes: Stock (upper): x 1.05 Arisings (upper) x 1.25
 Stock (lower): x 0.95 Arisings (lower) x 0.75

WASTE SOURCE The spent resins arise from operational de-mineralisers, whose primary function is reactor coolant purification and chemistry control.

PHYSICAL CHARACTERISTICS

General description: Spent resin waste contained in Ductile Cast Iron Casks. Waste is spent organic ion exchange resin comprising mixed anion and cation bead resin based on a styrene divinylbenzene co-polymer (DVB-styrene), in approximately a 50:50 (anion:cation) mix.

Physical components (%vol): Cast iron containers. Ion-exchange resin waste (Resin >99 vol%: ~49.9wt% water content) & interstitial water (<1 vol%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~4.6

Comment on density: Density includes cast iron cask.

CHEMICAL COMPOSITION

General description and components (%wt): Proprietary ion exchange resins, water in ductile cast iron casks. Some fine particulate corrosion products (activated) and insoluble particulate fission products in the waste. No other constituent is anticipated. Mixture of resins (including polystyrene bead resin) with both acidic functional groups in the lithium form and basic functional groups in the borate form. Exhausted sites rendered neutral.

Chemical state: Neutral

Chemical form of radionuclides: H-3: In interstitial water between the resin beads.
 C-14: Not determined.
 Cl-36: Not expected to be present in any measurable quantity.
 Se-79: Not expected to be present in any measurable quantity.
 Tc-99: Not expected to be present in any measurable quantity.
 I-129: Not determined.
 Ra: Not expected to be present in any measurable quantity.
 Th: Not determined.
 U: Trace quantities on the resin beads.
 Np: Not expected to be present in any measurable quantity.
 Pu: Trace quantities on the resin beads.

Metals and alloys (%wt): Not expected to be present

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	Stainless steel.....	TR	
	Other ferrous metals.....	~94.4	Ductile Cast iron.
	Iron.....	NE	
	Aluminium.....		
	Beryllium.....	0	
	Cobalt.....	TR	
	Copper.....		
	Lead.....	0	
	Magnox/Magnesium.....	0	
	Nickel.....		
	Titanium.....	NE	
	Uranium.....	0	
	Zinc.....	0	
	Zircaloy/Zirconium.....	0	
	Other metals.....	TR	
Organics (%wt):	Organic proprietary polystyrene/divinyl benzene copolymer ion exchange resins will be present. %ages based on resins in storage tanks.		
	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....	~5.6	Spent organic ion exchange resin comprising mixed anion and cation bead resin based on a styrene divinylbenzene co-polymer (DVB-styrene), in approximately a 50:50 (anion:cation) mix.
	Total rubber.....	0	
	Halogenated rubber	0	
	Non-halogenated rubber.....	0	
	Hydrocarbons.....	0	
	Oil or grease		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	TR	
Other materials (%wt):	Based on resins in storage tanks		

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	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	0	
	Sand.....	0	
	Glass/Ceramics.....	NE	
	Graphite.....	0	
	Desiccants/Catalysts.....	0	
	Asbestos.....	0	
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	<0.01	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	Other significant anions include Borate (~3%wt).		
	Fluoride.....	<0.01	
	Chloride.....	<0.01	
	Iodide.....	NE	
	Cyanide.....	NE	
	Carbonate.....	NE	
	Nitrate.....	NE	
	Nitrite.....	NE	
	Phosphate.....	NE	
	Sulphate.....	<0.01	
	Sulphide.....	NE	
Materials of interest for waste acceptance criteria:	There are no materials identified which are likely to pose a fire or other non-radiological hazard.		
	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.....	0	
	Corrosive materials.....	0	
	Pyrophoric materials.....	0	
	Generating toxic gases.....	0	
	Reacting with water.....	0	
	Active particles.....	P	May be present

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Soluble solids as bulk chemical compounds..... 0

Hazardous substances / non hazardous pollutants: Contains spent ion exchange resin - listed substance code 190806.

- Acrylamide..... NE
- Benzene..... NE
- Chlorinated solvents..... NE
- Formaldehyde..... NE
- Organometallics..... NE
- Phenol..... NE
- Styrene..... NE
- Tri-butyl phosphate..... NE
- Other organophosphates..... NE
- Vinyl chloride..... NE
- Arsenic..... NE
- Barium..... NE
- Boron..... NE
- Cadmium..... NE
- Caesium..... NE
- Selenium..... NE
- Chromium..... NE
- Molybdenum..... NE
- Thallium..... NE
- Tin..... NE
- Vanadium..... NE
- Mercury compounds..... NE
- Others..... NE

- Electronic Electrical Equipment (EEE)
 - EEE Type 1..... 0
 - EEE Type 2..... 0
 - EEE Type 3..... 0
 - EEE Type 4..... 0
 - EEE Type 5..... 0

- Complexing agents (%wt): Not yet determined
- EDTA..... NE
 - DPTA..... NE
 - NTA..... NE
 - Polycarboxylic acids..... NE
 - Other organic complexants..... NE
 - Total complexing agents..... TR

Complexing agents may be present in trace quantities.

PACKAGING AND CONDITIONING

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Container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l RS drum (0mm Pb)	72.0	~0.491	~0.491	111
	500 l RS drum (20mm Pb)	28.0	~0.43	~0.43	49

Container type comment: Campaign 1 used regular unshielded MOSAIK casks (Cast Iron) as will Campaign 2. Campaign 3 may use MOSAIK casks with either 20mm or 40mm lead lining.

Range in container waste volume: Use of 40mm lead lined casks for Campaign 3 will reduce payload to 0.382m³.

Other information on containers: A total of 159 casks are estimated throughout the entire disposal campaign.

Conditioned density (t/m³): ~4.6

Conditioned density comment: Density based on drained wasteform with 27% interstitial voidage in 1.32m³ casks.

Other information on conditioning: -

RADIOACTIVITY

Source: Spent ion exchange resin arising from the treatment of liquids. Contamination will be by fission and activation products, and trace quantities of actinides.

Uncertainty: The activity values quoted for existing waste is based on characterisation results. Activity of future arisings based on possible future contamination of resins with fission products. Waste that is processed during campaign 3 will be of higher activity than the previous campaigns.

Definition of total alpha and total beta/gamma: The majority listed stock alpha specific activities are all upper limits, therefore the total alpha activity will be less than the sum of the listed activities.

Measurement of radioactivities: Theoretical assessment. Some activity data comes from limited tank sampling activities.

Other information: -

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	1.96E-03	CC 2	1.58E-02	CC 2	Gd 153			2.20E-06	CC 2
Be 10			3.01E-09	CC 2	Ho 163			1.07E-07	CC 2
C 14	4.24E-02	CC 2	3.69E-02	CC 2	Ho 166m			1.57E-05	CC 2
Na 22		4		4	Tm 170			5.78E-06	CC 2
Al 26		4		4	Tm 171			5.05E-04	CC 2
Cl 36			7.92E-08	CC 2	Lu 174			8.19E-07	CC 2
Ar 39			3.28E-05	CC 2	Lu 176			1.02E-13	CC 2
Ar 42			1.88E-10	CC 2	Hf 178n			1.81E-05	CC 2
K 40			4.81E-11	CC 2	Hf 182			1.99E-10	CC 2
Ca 41			9.04E-08	CC 2	Pt 193			3.57E-07	CC 2
Mn 53			1.01E-12	CC 2	Tl 204			1.15E-04	CC 2
Mn 54	7.57E-05	CC 2	3.49E-02	CC 2	Pb 205			2.39E-12	CC 2
Fe 55	2.35E-02	CC 2	2.32E-01	CC 2	Pb 210			5.30E-10	CC 2
Co 60	4.27E-02	CC 2	4.29E-01	CC 2	Bi 208			1.21E-11	CC 2
Ni 59			6.17E-07	CC 2	Bi 210m			1.66E-12	CC 2
Ni 63	3.1E-01	CC 2	2.53E-01	CC 2	Po 210			1.54E-09	CC 2
Zn 65	<2.11E-08	C 3	1.47E-03	CC 2	Ra 223			1.57E-10	CC 2
Se 79			3.27E-08	CC 2	Ra 225			2.40E-07	CC 2
Kr 81			1.02E-07	CC 2	Ra 226			1.83E-09	CC 2
Kr 85	<1.83E-06	C 3	9.53E-03	CC 2	Ra 228			2.31E-07	CC 2
Rb 87			1.14E-10	CC 2	Ac 227			1.57E-10	CC 2
Sr 90	1.05E-03	CC 2	8.91E-03	CC 2	Th 227			1.54E-10	CC 2
Zr 93			9.09E-06	CC 2	Th 228	<5.61E-07	C 3	4.38E-07	CC 2
Nb 91			5.92E-09	CC 2	Th 229	<2.81E-07	C 3	2.40E-07	CC 2
Nb 92			6.25E-12	CC 2	Th 230	<2.81E-07	C 3	2.40E-07	CC 2
Nb 93m			4.02E-04	CC 2	Th 232	<3.51E-07	C 3	3.01E-07	CC 2
Nb 94			7.07E-06	CC 2	Th 234			6.91E-07	CC 2
Mo 93			1.57E-07	CC 2	Pa 231			3.87E-10	CC 2
Tc 97			5.88E-13	CC 2	Pa 233			1.72E-06	CC 2
Tc 99			6.69E-05	CC 2	U 232	<2.81E-07	C 3	2.09E-07	CC 2
Ru 106	<5.12E-05	C 3	7.35E-03	CC 2	U 233	9.12E-07	CC 2	5.74E-10	CC 2
Pd 107			7.14E-07	CC 2	U 234			1.14E-06	CC 2
Ag 108m			4.29E-07	CC 2	U 235			3.60E-08	CC 2
Ag 110m			7.07E-04	CC 2	U 236	<5.61E-07	C 3	4.74E-07	CC 2
Cd 109	<7.72E-08	C 3	1.31E-05	CC 2	U 238	<7.72E-07	C 3	6.91E-07	CC 2
Cd 113m	<3.51E-05	C 3	7.32E-05	CC 2	Np 237			1.72E-06	CC 2
Sn 119m			1.25E-06	CC 2	Pu 236			1.18E-08	CC 2
Sn 121m			1.20E-04	CC 2	Pu 238	8.98E-06	CC 2	9.28E-05	CC 2
Sn 123			3.49E-06	CC 2	Pu 239		6	3.64E-05	CC 2
Sn 126			1.06E-06	CC 2	Pu 240	<6.32E-07	C 3	3.65E-05	CC 2
Sb 125	<4.21E-08	C 3	3.13E-02	CC 2	Pu 241	<5.26E-05	C 3	5.52E-03	CC 2
Sb 126			3.41E-07	CC 2	Pu 242	<3.16E-07	C 3	3.83E-07	CC 2
Te 125m			7.84E-03	CC 2	Am 241	<4.91E-07	C 3	1.76E-04	CC 2
Te 127m			2.06E-05	CC 2	Am 242m	<6.32E-08	C 3	6.37E-07	CC 2
I 129	<1.75E-07	C 3	2.32E-07	CC 2	Am 243	<4.91E-08	C 3	2.28E-06	CC 2
Cs 134	1.48E-02	CC 2	2.95E-02	CC 2	Cm 242	<4.91E-08	C 3	1.92E-06	CC 2
Cs 135			2.55E-06	CC 2	Cm 243			1.07E-07	CC 2
Cs 137	3.25E-01	CC 2	3.87E-01	CC 2	Cm 244	<1.40E-08	C 3	1.40E-05	CC 2
Ba 133			1.35E-05	CC 2	Cm 245			3.63E-06	CC 2
La 137			1.54E-08	CC 2	Cm 246	<7.02E-09	C 3	1.02E-06	CC 2
La 138			2.25E-14	CC 2	Cm 248			4.74E-11	CC 2
Ce 144	<2.81E-08	C 3	3.61E-03	CC 2	Cf 249			4.97E-10	CC 2
Pm 145			5.15E-08	CC 2	Cf 250			3.05E-09	CC 2
Pm 147	<1.05E-05	C 2	3.02E-02	CC 2	Cf 251			4.71E-11	CC 2
Sm 147			1.59E-11	CC 2	Cf 252			1.28E-09	CC 2
Sm 151			1.46E-03	CC 2	Other a		8		8
Eu 152			1.51E-06	CC 2	Other b/g	<7.02E-04	C 3		6
Eu 154	<3.51E-08	C 3	1.26E-02	CC 2	Total a	<1.48E-05	C 3	3.70E-04	CC 2
Eu 155	<1.40E-08	C 3	3.10E-03	CC 2	Total b/g	7.62E-01	CC 2	1.54E+00	CC 2

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