

WASTE STREAM	3M08	Active Effluent Ion Exchange Material
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SITE Heysham 2

SITE OWNER EDFE NGL

WASTE CUSTODIAN EDFE NGL

WASTE TYPE ILW; SPD1

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0.5 m ³
Future arisings -	1.4.2019 - 31.3.2030.....	0.6 m ³
	1.4.2030 - 31.3.2032.....	0.2 m ³
	1.4.2032 - 31.3.2033.....	0.9 m ³
	1.4.2033 - 31.3.2034.....	1.1 m ³
Total future arisings:		2.8 m ³
Total waste volume:		3.3 m ³

Comment on volumes: Waste volumes will be variable depending on station operating conditions.

Uncertainty factors on volumes: Stock (upper): x 1.5 Arisings (upper) x 1.5
 Stock (lower): x 0.5 Arisings (lower) x 0.5

WASTE SOURCE Spent Ion Exchange materials. There may be traces of sludge associated with the ion exchange material.

PHYSICAL CHARACTERISTICS

General description: The waste is expected to be IRN 150L polystyrene bead ion exchange material of particle size range 0.3 - 1.2 mm. There are no large items which may require special handling.

Physical components (%vol): Ion exchange material (drained water-saturated beads ~70% vol), water (interstitial ~30% vol) and possibly traces of sludge.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.1

Comment on density: -

CHEMICAL COMPOSITION

General description and components (%wt): Proprietary ion exchange materials (~35% bone-dry wt), water (absorbed plus interstitial ~65% wt) and possibly traces of sludge. The proprietary ion exchange material normally used is expected to be an organic bead resin (polystyrene cross linked with divinyl benzene), (IRN 150L).

Chemical state: -

Chemical form of radionuclides: H-3: The waste is expected to contain some tritiated liquor.
 C-14: Not determined
 Cl-36: Not determined
 Se-79: Not expected to be significant
 Tc-99: Not expected to be significant
 I-129: Not expected to be significant
 Ra: Not determined
 Th: Not determined
 U: Not determined
 Np: Not determined
 Pu: Not determined

Metals and alloys (%wt): -

Stainless steel.....	NE
Other ferrous metals.....	NE
Iron.....	NE
Aluminium.....	NE
Beryllium.....	NE
Cobalt.....	NE
Copper.....	NE

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	Lead.....	NE
	Magnox/Magnesium.....	NE
	Nickel.....	NE
	Titanium.....	NE
	Uranium.....	NE
	Zinc.....	NE
	Zircaloy/Zirconium.....	NE
	Other metals.....	NE
Organics (%wt):	Proprietary ion-exchange resins (approx 35% dry weight, 65% absorbed water)	
	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....	~100.0
	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.....	NE
Other materials (%wt):	-	
	Inorganic ion exchange materials.	0
	Inorganic sludges and flocs.....	NE
	Soil.....	0
	Brick/Stone/Rubble.....	0
	Cementitious material.....	0
	Sand.....	~0
	Glass/Ceramics.....	
	Graphite.....	0
	Desiccants/Catalysts.....	0
	Asbestos.....	0
	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	

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	Free aqueous liquids.....	NE	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	Not assessed.		
	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:	Ion exchange resins are combustible if dry. There might be trace quantities of biological material.		
	Combustible metals.....	0	
	Low flash point liquids.....	0	
	Explosive materials.....	0	
	Phosphorus.....	0	
	Hydrides.....	0	
	Biological etc. materials.....		
	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
	Soluble solids as bulk chemical compounds.....	0	
Hazardous substances / non hazardous pollutants:	-		
	Acrylamide.....	NE	
	Benzene.....	NE	
	Chlorinated solvents.....	NE	
	Formaldehyde.....	NE	
	Organometallics.....	NE	
	Phenol.....	NE	
	Styrene.....	NE	
	Tri-butyl phosphate.....	NE	
	Other organophosphates.....	NE	

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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.....	NE

Possibly in trace quantities.

PACKAGING AND CONDITIONING

Conditioning method:	The waste is expected to be encapsulated in a BFS/OPC matrix. Other approaches under review are (1) wet oxidation followed by drying and supercompaction (2) drying and supercompaction. Drums of supercompacted waste would be grouted in an "enhanced" drum.
Plant Name:	None.
Location:	Heysham 2 Power Station.
Plant startup date:	Between 2035 and 2038.
Total capacity (m ³ /y incoming waste):	~175.0
Target start date for packaging this stream:	-
Throughput for this stream (m ³ /y incoming waste):	~
Other information:	All waste in a tank will be retrieved when a conditioning campaign is undertaken. It is expected there will be several campaigns.

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Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l drum	100.0	~0.2	0.47	17

Likely container type comment: -

Range in container waste volume: -

Other information on containers: Stainless Steel

Likely conditioning matrix: BFS/OPC
 Other information: A 9:1 BFS/OPC matrix is expected to be used.

Conditioned density (t/m³): ~1.7
 Conditioned density comment: Density may vary from 1.62 to 1.72 t/m³.

Other information on conditioning: Appropriate plant to be provided at the station in accordance with EDF Energy strategy.

Opportunities for alternative disposal routing: No

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source: Spent Ion Exchange resins. Contamination by activation products will be a main source of activity.

Uncertainty: Activity based on Torness data.

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: Activity based on Torness data.

Other information: Other beta/gamma nuclides of stocks and arisings (in TBq/m³) include; S35 (2E-3, 3E-7); Ca45 (5E-3, 5E-5); Cr51 (2E-3, 2E-15); Co58 (3E-2, 7E-7); Zr95 (7E-6, 5E-11); Nb95 (7E-6, 3E-15); Ru103 (3E-6, 1E-14), Ta182 (5E-2, 7E-5); P32 (8E-5, 6E-28), Fe59 (3E-4, 1E-11); Ce141 (4E-6, 3E-16); Tb 160 (5E-6, 1E-10) and Hf181 (5E-6, 8E-14).

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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	1.32E-06	CC 2	2.67E-06	DD 2	Gd 153				
Be 10					Ho 163				
C 14	4.25E-07	CC 2	4.25E-07	DD 2	Ho 166m				
Na 22		4		4	Tm 170				
Al 26		4		4	Tm 171				
Cl 36	6.1E-07	CC 2	6.1E-07	DD 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40	4.1E-06	C 3	4.1E-06	D 3	Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	6.94E-04	CC 2	1.16E-02	DD 2	Pb 205				
Fe 55	1.49E-02	CC 2	1.22E-01	DD 2	Pb 210	3.8E-05	CC 2	5.78E-05	DD 2
Co 60	1.31E-03	CC 2	4.94E-03	DD 2	Bi 208				
Ni 59					Bi 210m				
Ni 63	2.03E-03	CC 2	2.03E-03	DD 2	Po 210				
Zn 65	4.3E-06	C 3	8.39E-05	D 3	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	9.7E-05	CC 2	9.7E-05	DD 2
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	2.33E-04	CC 2	3.24E-04	DD 2	Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94	4.4E-06	C 3	4.4E-06	D 3	Th 234	6.7E-05	CC 2	2.01E-03	DD 2
Mo 93					Pa 231				
Tc 97					Pa 233	6.5E-06	CC 2	1.95E-04	DD 2
Tc 99					U 232				
Ru 106	5E-05	C 3	7.40E-04	D 3	U 233				
Pd 107					U 234	1.1E-07	CC 2	1.1E-07	DD 2
Ag 108m	2E-06	CC 2	2E-06	DD 2	U 235	5.8E-08	CC 2	5.8E-08	DD 2
Ag 110m	4.5E-06	CC 2	8.56E-05	DD 2	U 236				
Cd 109					U 238	6.5E-08	CC 2	6.5E-08	DD 2
Cd 113m					Np 237	1.9E-05	CC 2	1.9E-05	DD 2
Sn 119m					Pu 236				
Sn 121m					Pu 238	2E-05	CC 2	2.24E-05	DD 2
Sn 123					Pu 239		6		6
Sn 126					Pu 240	3.23E-05	CC 2	3.23E-05	DD 2
Sb 125	2.5E-05	C 3	1.65E-04	D 3	Pu 241	1.31E-03	CC 2	2.42E-03	DD 2
Sb 126					Pu 242	8.3E-07	CC 2	8.3E-07	DD 2
Te 125m					Am 241	9.04E-05	CC 2	9.04E-05	DD 2
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	1.16E-03	CC 2	9.94E-03	DD 2	Cm 242	4.2E-07	CC 2	9.90E-06	DD 2
Cs 135					Cm 243	5.85E-06	CC 2	8.07E-06	DD 2
Cs 137	3.39E-02	CC 2	4.64E-02	DD 2	Cm 244	5.85E-06	CC 2	9.65E-06	DD 2
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	1.4E-05	CC 2	2.47E-04	DD 2	Cf 249				
Pm 145					Cf 250				
Pm 147	2.65E-04	CC 2	1.86E-03	DD 2	Cf 251				
Sm 147					Cf 252				
Sm 151	1.6E-05	CC 2	1.78E-05	DD 2	Other a	1.42E-03	CC 2	1.42E-03	DD 2
Eu 152	5.3E-06	C 3	1.01E-05	D 3	Other b/g	7.19E-05	CC 2	7.19E-05	DD 2
Eu 154	4.22E-05	CC 2	1.08E-04	DD 2	Total a	1.69E-03	CC 2	<1.71E-03	DD 2
Eu 155	2.56E-05	CC 2	1.05E-04	DD 2	Total b/g	5.62E-02	CC 2	2.06E-01	DD 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