

<b>WASTE STREAM</b>	<b>4B04</b>	<b>Sludge</b>
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**SITE** Hunterston B

**SITE OWNER** EDFE NGL

**WASTE CUSTODIAN** EDFE NGL

**WASTE TYPE** ILW; SPD1

Is the waste subject to Scottish Policy: Yes

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	43.5 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2023.....	0.7 m <sup>3</sup>
	1.4.2023 - 31.3.2024.....	1.4 m <sup>3</sup>
	1.4.2024 - 31.3.2025.....	1.4 m <sup>3</sup>
Total future arisings:		3.5 m <sup>3</sup>
Total waste volume:		47.0 m <sup>3</sup>

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

Uncertainty factors on volumes: Stock (upper): x 1.25 Arisings (upper) x 1.5  
 Stock (lower): x 0.75 Arisings (lower) x 0.5

**WASTE SOURCE** Waste consists of sludges generated during normal station operation.

**PHYSICAL CHARACTERISTICS**

General description: The waste consists of sludges including spent precoat, particulate iron, spalled oxide and sand. This waste is not expected to contain any large items. No detailed breakdown available.

Physical components (%vol): Sand, sludge and water (100%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~1.9

Comment on density: The density is estimated.

**CHEMICAL COMPOSITION**

General description and components (%wt): Sludge composition varies as the waste arises from several sources. The waste is expected to contain silica (sand), precoat filter material, and sludge from various sources. Exact chemical composition details have not been determined.

Chemical state: Neutral

Chemical form of radionuclides: H-3: As Tritiated Water  
 C-14: Not expected to be significant  
 Cl-36: Not expected to be significant  
 Se-79: Not Assessed  
 Tc-99: Not Assessed  
 I-129: Not expected to be significant  
 Ra: Not expected to be significant  
 Th: Not Assessed  
 U: Not Assessed  
 Np: Not expected to be significant  
 Pu: Not Assessed

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	0		
Iron.....	0		
Aluminium.....	0		
Beryllium.....	0		

<b>WASTE STREAM</b>	<b>4B04</b>	<b>Sludge</b>
---------------------	-------------	---------------

Cobalt.....	0
Copper.....	0
Lead.....	0
Magnox/Magnesium.....	0
Nickel.....	0
Titanium.....	0
Uranium.....	0
Zinc.....	0
Zircaloy/Zirconium.....	0
Other metals.....	0

Organics (%wt):                      The waste contains solkafloc cellulose filter material and some oil.

	(%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....	0		
Total rubber.....	0		
Halogenated rubber .....	0		
Non-halogenated rubber.....	0		
Hydrocarbons.....	NE		
Oil or grease .....	NE		
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.....	~100.0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....	NE		
Glass/Ceramics.....	0		
Graphite.....	0		

<b>WASTE STREAM</b>	<b>4B04</b>	<b>Sludge</b>
---------------------	-------------	---------------

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

Inorganic anions (%wt):           Trace quantities only of the listed inorganic anions might be expected.

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

Materials of interest for           There are no hazardous materials present.  
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.....	0	
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....	P	May be present
Soluble solids as bulk chemical compounds.....	0	

<b>WASTE STREAM</b>	<b>4B04</b>	<b>Sludge</b>
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Hazardous substances /  
non hazardous pollutants:

This waste is not expected to contain any listed substances.

	(%wt)	Type(s) and comment
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	
Boron (in Boral).....	NE	
Boron (non-Boral).....	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

	(%wt)	Type(s) and comment
EDTA.....	NE	
DPTA.....	NE	
NTA.....	NE	
Polycarboxylic acids.....	NE	
Other organic complexants.....	NE	Trace quantities of complexing agents used in the decontamination process may be present.
Total complexing agents.....	NE	

<b>WASTE STREAM</b>	<b>4B04</b>	<b>Sludge</b>
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Potential for the waste to contain discrete items: No.

**PACKAGING AND CONDITIONING**

Conditioning method: Sludge will be dewatered prior to encapsulation in cement. Supercompaction will not be used.

Plant Name: Radwaste Conditioning and Packaging Plant.

Location: Hunterston B Power Station.

Plant startup date: Probably between 2023 and 2028.

Total capacity (m<sup>3</sup>/y incoming waste): NE

Target start date for packaging this stream: -

Throughput for this stream (m<sup>3</sup>/y incoming waste): NE

Other information: All waste in a tank will be retrieved when a conditioning campaign is undertaken. It is expected that there will be several campaigns.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	500 l drum	100.0	~0.24	0.47	196

Likely container type comment: -

Range in container waste volume: -

Other information on containers: Stainless Steel.

Likely conditioning matrix: BFS/OPC

Other information: A cement blend of BFS/OPC has been considered.

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

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at a Near Surface / Near Site Disposal Facility	Incineration	100.0	2026	Medium	Based on preliminary characterisation data, however future arisings from defuelling and decommissioning will be added to tanks.

**RADIOACTIVITY**

Source: There will be contamination by fission products and activation products.

Uncertainty: The estimate of total activity in stocks is within a factor of 10.

**WASTE STREAM****4B04****Sludge**

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:

-

Other information:

The specific activity at various times in the operating history of the plant will vary widely. The estimates are based upon theoretical assessments expected after several years of operation. Other beta/gamma nuclides of arisings and stocks (in TBq/m<sup>3</sup>) include; Cr51 (1E+1, 4E-3); Co58 (1E+0, 7E-3); Ru103 (4E-9, 6E-12); I125 (5E-9, 2E-11) and Ta182 (7E-1, 1E-2).

**WASTE STREAM 4B04 Sludge**

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	1.23E-04	cc 1	1.23E-04	cc 1	Gd 153				
Be 10					Ho 163				
C 14	2.50E-05	cc 1	2.50E-05	cc 1	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36	1.84E-06	cc 1	1.84E-06	cc 1	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	3.19E-06	cc 1	3.19E-06	cc 1	Pb 205				
Fe 55	2.92E-04	cc 1	2.92E-04	cc 1	Pb 210				
Co 60	2.59E-04	cc 1	2.59E-04	cc 1	Bi 208				
Ni 59					Bi 210m				
Ni 63	3.55E-04	cc 1	3.55E-04	cc 1	Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	2.38E-06	cc 1	2.38E-06	cc 1	Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235	3.10E-09	cc 1	3.10E-09	cc 1
Ag 110m					U 236				
Cd 109					U 238	2.00E-08	cc 1	2.00E-08	cc 1
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238	7.52E-06	cc 1	7.52E-06	cc 1
Sn 123					Pu 239	1.54E-05	cc 1	1.54E-05	cc 1
Sn 126					Pu 240	1.54E-05	cc 1	1.54E-05	cc 1
Sb 125					Pu 241	3.04E-04	cc 1	3.04E-04	cc 1
Sb 126					Pu 242				
Te 125m					Am 241	3.18E-05	cc 1	3.18E-05	cc 1
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	7.66E-07	cc 1	7.66E-07	cc 1	Cm 242	1.04E-07	cc 1	1.04E-07	cc 1
Cs 135					Cm 243	6.28E-07	cc 1	6.28E-07	cc 1
Cs 137	2.24E-04	cc 1	2.24E-04	cc 1	Cm 244	6.28E-07	cc 1	6.28E-07	cc 1
Ba 133					Cm 245	1.87E-07	cc 1	1.87E-07	cc 1
La 137					Cm 246	1.87E-07	cc 1	1.87E-07	cc 1
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147	1.21E-05	cc 1	1.21E-05	cc 1	Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g	2.69E-06	cc 1	2.69E-06	cc 1
Eu 154	4.27E-06	cc 1	4.27E-06	cc 1	<b>Total a</b>	<b>7.19E-05</b>	<b>cc 1</b>	<b>7.19E-05</b>	<b>cc 1</b>
Eu 155	1.14E-06	cc 1	1.14E-06	cc 1	<b>Total b/g</b>	<b>1.61E-03</b>	<b>cc 1</b>	<b>1.61E-03</b>	<b>cc 1</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