

<b>WASTE STREAM</b>	<b>4C12</b>	<b>Miscellaneous Activated Components &amp; Fuel Stringer Debris</b>
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**SITE** Torness

**SITE OWNER** EDFE NGL

**WASTE CUSTODIAN** EDFE NGL

**WASTE TYPE** ILW; SPD3

Is the waste subject to Scottish Policy: Yes

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	162.4 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2028.....	48.0 m <sup>3</sup>
	1.4.2028 - 31.3.2030.....	34.0 m <sup>3</sup>
Total future arisings:		82.0 m <sup>3</sup>
Total waste volume:		244.4 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** The waste is primarily produced as a result of dismantling fuel stringers.

**PHYSICAL CHARACTERISTICS**

General description: The waste includes tiebar sections, top reflectors, central inertial collectors, anti-gapping units, piston seals and cartridge assemblies, stabilising brushes, other miscellaneous components, control rods and parts of control rod chains, neutron shield plugs and flux measuring detectors. Some additional high activity components, in steel tins, may also be present. Some large items may be present in the waste.

Physical components (%vol): Top reflector assembly (~15%), finned upper stabilising brush assembly (~6%), vacancy stringer (~54%), bottom support reflector assembly (~20%), other wastes (~5%). The volume breakdown is based on stocks to date and is subject to change.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): 0.3

Comment on density: The estimated waste density is 0.3 t/m<sup>3</sup>.

**CHEMICAL COMPOSITION**

General description and components (%wt): The waste is predominantly stainless steel and graphite. There will be traces of organic materials (e.g. oil) and complexing agents (e.g. decontamination chemicals). The material breakdown for stocks is somewhat different from arisings, vacancy blocks being present in the stocks but not in the arisings. The breakdown given is for the whole waste stream i.e. stocks plus arisings. Stainless steel (85%), graphite (10%), nimonic PE16 and other materials (5%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Diffused into materials  
C-14: Graphite  
Cl-36: Incorporated into steels  
Se-79: Not expected to be significant  
Tc-99: Not expected to be significant  
I-129: Not expected to be significant  
Ra: Not expected to be significant  
Th: Not expected to be significant  
U: Not expected to be significant  
Np: Not expected to be significant  
Pu: Not expected to be significant

Metals and alloys (%wt): Some large items may be present in the waste.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~85.0		
Other ferrous metals.....	NE		
Iron.....	NE		
Aluminium.....	NE		
Beryllium.....	NE		
Cobalt.....	NE		
Copper.....	NE		
Lead.....	NE		
Magnox/Magnesium.....	NE		
Nickel.....	~5.0		
Titanium.....	NE		
Uranium.....	NE		
Zinc.....	NE		
Zircaloy/Zirconium.....	NE		
Other metals.....	NE		

Organics (%wt):                      The waste is expected to contain trace quantities of organic material, but this is thought to be insignificant.

	(%wt)	Type(s) and comment	% of total C14 activity
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....	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.....	0		

Other materials (%wt):                      -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	10.0		
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt):           The waste is not expected to contain any inorganic anions.

	(%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 waste acceptance criteria:           There are no hazardous materials present.

	(%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	

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	P
Soluble solids as bulk chemical compounds.....	0

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	

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....	NE	
DPTA.....	NE	
NTA.....	NE	
Polycarboxylic acids.....	NE	
Other organic complexants.....	NE	The waste will contain traces of complexing agents.
Total complexing agents.....	NE	

Potential for the waste to contain discrete items: Yes.

**PACKAGING AND CONDITIONING**

Conditioning method: The waste will be conditioned to satisfy the disposal requirements which are effective at the time of retrieval/conditioning. It is currently assumed that the waste will be placed in "baskets" in the waste packages and will be encapsulated.

Plant Name: Radwaste Conditioning and Packaging Plant.

Location: Torness Power Station.

Plant startup date: 85 Years following Station Shutdown

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 of the waste is expected to be retrieved and conditioned when a conditioning campaign is undertaken. The total plant process rate is not estimated.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	4m box (100mm concrete shielding)	100.0	~12.2	~14.3	21

Likely container type comment: -

Range in container waste volume: -

Other information on containers: Stainless steel.

Likely conditioning matrix: BFS/OPC

Other information: -

Conditioned density (t/m<sup>3</sup>): ~2.4Conditioned density comment: Conditioned density is assumed to be between 2-3 t/m<sup>3</sup>

Other information on conditioning: Waste will be retained on site pending Final Site Clearance, to let nuclides such as Co-60 undergo considerable radioactive decay. Baskets of different Final Site Clearance ILW wastes may be in the same waste package.

Opportunities for alternative disposal routing: No

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Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
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**RADIOACTIVITY**

Source:	Predominantly activation products within the materials.
Uncertainty:	Activity derived from theoretical estimates within a factor of 10.
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:	Theoretical values.
Other information:	-

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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	*9E-01	CC 2	*6.6E-01	CC 2	Gd 153				
Be 10	*2.1E-10	CC 2	*6.9E-13	CC 2	Ho 163				
C 14	*8.7E-02	CC 2	*4.6E-02	CC 2	Ho 166m				
Na 22		4		4	Tm 170				
Al 26		4		4	Tm 171				
Cl 36	*3.4E-05	CC 2	*3.4E-05	CC 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	2.8E-01	CC 2	6.3E+00	CC 2	Pb 205				
Fe 55	*3.7E+02	CC 2	*1.3E+03	CC 2	Pb 210				
Co 60	*4.3E+02	CC 2	*8.3E+01	CC 2	Bi 208				
Ni 59	*1.2E+00	CC 2	*6.6E-01	CC 2	Bi 210m				
Ni 63	*1.5E+02	CC 2	*8.7E+01	CC 2	Po 210				
Zn 65					Ra 223				
Se 79	*2.24E-06	CC 2	*1.26E-06	CC 2	Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	*8E-03	CC 2	*3.1E-03	CC 2	Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232	*8.5E-09	CC 2	*3.1E-09	CC 2
Nb 94	*2.9E-02	CC 2	*1.6E-02	CC 2	Th 234				
Mo 93	*1.6E-02	CC 2	*8.9E-03	CC 2	Pa 231	*2E-07	CC 2	*6.7E-08	CC 2
Tc 97					Pa 233				
Tc 99	*7.5E-04	CC 2	*4.2E-04	CC 2	U 232				
Ru 106					U 233	*1.3E-05	CC 2	*4.8E-06	CC 2
Pd 107					U 234	*7.2E-07	CC 2	*2.5E-07	CC 2
Ag 108m					U 235	*2.8E-10	CC 2	*9.7E-11	CC 2
Ag 110m					U 236	*5.1E-09	CC 2	*1.8E-09	CC 2
Cd 109					U 238	*2.6E-08	CC 2	*9E-09	CC 2
Cd 113m					Np 237	*5.7E-09	CC 2	*1.7E-09	CC 2
Sn 119m					Pu 236				
Sn 121m					Pu 238	*1.7E-05	CC 2	*6.4E-06	CC 2
Sn 123					Pu 239	*1.1E-04	CC 2	*3.7E-05	CC 2
Sn 126					Pu 240	*9.3E-05	CC 2	*3.2E-05	CC 2
Sb 125					Pu 241	*5.6E-03	CC 2	*2.6E-03	CC 2
Sb 126					Pu 242	*2.4E-07	CC 2	*8.7E-08	CC 2
Te 125m					Am 241	*4.9E-04	CC 2	*1.5E-04	CC 2
Te 127m					Am 242m	*2.2E-06	CC 2	*8E-07	CC 2
I 129	*6E-09	CC 2	*2.1E-09	CC 2	Am 243	*8.4E-07	CC 2	*3E-07	CC 2
Cs 134					Cm 242				
Cs 135	*2.2E-07	CC 2	*7.4E-08	CC 2	Cm 243				
Cs 137	*1.4E-02	CC 2	*5.5E-03	CC 2	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					<b>Total a</b>	<b>*7.25E-04</b>	<b>CC 2</b>	<b>*2.31E-04</b>	<b>CC 2</b>
Eu 155					<b>Total b/g</b>	<b>*9.53E+02</b>	<b>CC 2</b>	<b>*1.48E+03</b>	<b>CC 2</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