

WASTE STREAM	3L311	Decommissioning Stage 3: Stainless Steel (Reactor) ILW
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SITE Heysham 1

SITE OWNER EDFE NGL

WASTE CUSTODIAN EDFE NGL

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

	Reported
Stocks: At 1.4.2022.....	0 m ³
Future arisings - 1.4.2022 - 31.3.2112.....	0 m ³
1.4.2112 - 31.3.2113.....	72.2 m ³
1.4.2113 - 31.3.2114.....	79.2 m ³
1.4.2114 - 31.3.2115.....	67.8 m ³
Total future arisings:	219.1 m ³
Total waste volume:	219.1 m ³

Comment on volumes: Waste volumes will be variable depending on station operating conditions. Volumes based on Back to Bio Shield strategy. Work is ongoing looking at optimising the strategy which could lead to a change in volume and timings of arisings across Final Site Clearance wastes (300s) and Pre C&M wastes (100s), in future submissions.

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

WASTE SOURCE Stainless steel items (including Control rods) from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: A variety of stainless steel items. Waste can be packaged in standard NDA packages.

Physical components (%vol): Stainless steel items (100%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.4

Comment on density: The density is of the waste as cut for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): Almost completely stainless steel (100%) with possibly a trace of other metals. Percentages of steels based on Heysham 2/Torness Values.

Chemical state: -

Chemical form of radionuclides: H-3: Diffused into matrix
 C-14: Incorporated in the steel. There may be some surface contamination as graphite.
 Cl-36: The chlorine will be incorporated in the steel
 Se-79: Selenium content not expected to be significant
 Tc-99: Not determined
 I-129: Not determined
 Ra: Radium content is insignificant
 Th: Thorium content is Insignificant
 U: Not determined
 Np: The neptunium content is insignificant
 Pu: Not determined

Metals and alloys (%wt): The waste will be bulk metal items which have been cut for packaging. Metal thicknesses will range from a few mm to about 50mm.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	100.0	316SS (52.3%), 304SS(31.4%), 321SS(16.3%).	100.0
Other ferrous metals.....	0		
Iron.....	0		

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Aluminium.....	0
Beryllium.....	0
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): None expected.

	(%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): -

	(%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		

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Glass/Ceramics.....	0	
Graphite.....	~0	Graphite dust will be associated with waste.
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): None likely to be present.

	(%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: 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.....	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	

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Hazardous substances /
non hazardous pollutants:

Non Radioactive hazardous materials are not expected.

	(%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	Only trace quantities, if any.
Total complexing agents.....	NE	

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Potential for the waste to contain discrete items: Yes.

PACKAGING AND CONDITIONING

Conditioning method: The waste is not expected to be supercompacted. It will be placed in 'baskets' in the waste packages, and is assumed to be encapsulated.

Plant Name: -

Location: -

Plant startup date: 85 years after reactor shut down.

Total capacity (m³/y incoming waste): ~5000.0

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): -

Other information: Waste will be conditioned when removed from the reactor.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	4m box (100mm concrete shielding)	100.0	~12.2	~14.3	18

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/m³): ~3.06

Conditioned density comment: Assumes waste will be encapsulated, matrix would be likely to be BFS/OPC.

Other information on conditioning: The waste will be in baskets placed in the waste packages. Baskets of different Stage 3 ILW wastes may be in the same waste package.

Opportunities for alternative disposal routing: Not yet determined

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

RADIOACTIVITY

Source: Activation of the stainless steel and impurities.

Uncertainty: The values quoted were derived by calculation from available material specification and are indicative of the activities that are expected. A major source of uncertainty is the impurity levels.

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'.

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Measurement of
radioactivities:

Activation/decay calculations based on Neutron flux and projected operating history.

Other information:

The activities quoted are for the time at which this waste will arise (i.e. ~85 years after end of generation). There may be some contamination by Cs137.

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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				8	Gd 153				
Be 10					Ho 163				
C 14			1.3E-02	CC 2	Ho 166m				
Na 22				4	Tm 170				
Al 26				4	Tm 171				
Cl 36			1E-05	CC 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41				8	Pt 193				
Mn 53					Tl 204				
Mn 54				8	Pb 205				
Fe 55			2.01E-08	CC 2	Pb 210				8
Co 60			9.17E-05	CC 2	Bi 208				
Ni 59			2.5E-02	CC 2	Bi 210m				
Ni 63			1.53E+00	CC 2	Po 210				8
Zn 65				8	Ra 223				
Se 79				8	Ra 225				
Kr 81					Ra 226				8
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90				8	Th 227				
Zr 93				8	Th 228				
Nb 91					Th 229				8
Nb 92					Th 230				8
Nb 93m			1.41E-05	CC 2	Th 232				8
Nb 94			1.78E-05	CC 2	Th 234				
Mo 93			1.28E-04	CC 2	Pa 231				8
Tc 97					Pa 233				
Tc 99			2.36E-05	CC 2	U 232				
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			1.8E-06	CC 2	U 235				8
Ag 110m					U 236				8
Cd 109					U 238				8
Cd 113m					Np 237				8
Sn 119m					Pu 236				
Sn 121m				8	Pu 238				8
Sn 123					Pu 239				8
Sn 126				8	Pu 240				8
Sb 125					Pu 241				8
Sb 126					Pu 242				8
Te 125m					Am 241				8
Te 127m					Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137				8	Cm 244				8
Ba 133					Cm 245				8
La 137					Cm 246				8
La 138					Cm 248				
Ce 144				8	Cf 249				
Pm 145					Cf 250				
Pm 147				8	Cf 251				
Sm 147					Cf 252				
Sm 151				8	Other a				8
Eu 152				8	Other b/g				8
Eu 154				8	Total a	0	<1E-09		8
Eu 155				8	Total b/g	0	1.57E+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