

<b>WASTE STREAM</b>	<b>4B315</b>	<b>Decommissioning Stage 3: Mild Steel (Reactor) LLW</b>
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**SITE** Hunterston B

**SITE OWNER** EDFE NGL

**WASTE CUSTODIAN** EDFE NGL

**WASTE TYPE** LLW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	0 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2109.....	0 m <sup>3</sup>
	1.4.2109 - 31.3.2110.....	94.6 m <sup>3</sup>
	1.4.2110 - 31.3.2111.....	921.3 m <sup>3</sup>
	1.4.2111 - 31.3.2112.....	921.3 m <sup>3</sup>
	1.4.2112 - 31.3.2113.....	469.1 m <sup>3</sup>
Total future arisings:		2406.3 m <sup>3</sup>
Total waste volume:		2406.3 m <sup>3</sup>

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** Mild steel items from the reactor structure.

**PHYSICAL CHARACTERISTICS**

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

Physical components (%wt): Mild steel items (100%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~1.4

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

**CHEMICAL COMPOSITION**

General description and components (%wt): A variety of mild steels (100%) with possible traces of other metals.

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 significant  
 Ra: Radium content is insignificant  
 Th: Thorium content is Insignificant  
 U: Uranium content is Insignificant  
 Np: The neptunium content is insignificant  
 Pu: Plutonium content is insignificant

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.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	100.0		100.0
Iron.....	0		
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):		-	

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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.....	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):           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	

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Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....	P	Not expected.
Soluble solids as bulk chemical compounds.....	0	

Hazardous substances /  
non hazardous pollutants: -

	(%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): 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	

Potential for the waste to contain discrete items: Yes.

**TREATMENT, PACKAGING AND DISPOSAL**

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None	Off-site	~80.0           ~20.0

Comment on planned treatments:

Approximately 80% of the waste will be suitable for decontamination and melting and 95% is expected to be suitable for re-use.

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known	~24.0    ~76.0	~1.4    ~1.4

Classification codes for waste expected to be consigned to a landfill facility: -

**Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):**

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known			

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Opportunities for alternative disposal routing: -

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

**Waste Packaging for Disposal:**

Container	Stream volume %	Waste loading m <sup>3</sup>	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	24.0	14.75	40

Other information: -

**Waste Planned for Disposal at the LLW Repository:**

Container voidage: -

Waste Characterisation Form (WCH): It is not yet determined if the waste meets LLWR's Waste Acceptance Criteria (WAC).

Waste consigned for disposal to LLWR in year of generation: Yes.

**Non-Containerised Waste for In-Vault Grouting:** (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

**RADIOACTIVITY**

Source: Activation of the mild steel and its impurities.

Uncertainty: The values quoted were derived by calculation from available material specifications and are indicative of the activities that are to be 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'.

Measurement of radioactivities: Activation/decay calculations based on neutron flux and projected operating history.

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

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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				8	Gd 153				
Be 10				8	Ho 163				
C 14			1.3E-05	CC 2	Ho 166m				
Na 22				4	Tm 170				
Al 26				4	Tm 171				
Cl 36				8	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			1.23E-10	CC 2	Pb 210				8
Co 60			4.34E-07	CC 2	Bi 208				
Ni 59			2.41E-06	CC 2	Bi 210m				
Ni 63			1.29E-04	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			6.89E-08	CC 2	Th 232				8
Nb 94			2.34E-07	CC 2	Th 234				
Mo 93			1.34E-06	CC 2	Pa 231				8
Tc 97					Pa 233				
Tc 99			2.88E-07	CC 2	U 232				
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			3.77E-08	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	<b>Total a</b>	<b>0</b>	<b>&lt;1E-09</b>		<b>8</b>
Eu 155				8	<b>Total b/g</b>	<b>0</b>	<b>1.47E-04</b>	<b>CC 2</b>	<b>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