SITE Hunterston A SITE OWNER **Nuclear Decommissioning Authority WASTE CUSTODIAN** Magnox Limited LLW **WASTE TYPE** Is the waste subject to No Scottish Policy: **WASTE VOLUMES** Reported At 1.4.2022..... Stocks:  $0 \, \text{m}^3$ 1.4.2075 - 31.3.2080...... Future arisings -2861.0 m<sup>3</sup> Total future arisings: 2861.0 m<sup>3</sup> Total waste volume: 2861.0 m<sup>3</sup> Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 5 years. Final Dismantling & Site Clearance is assumed to commence in 2071 with reactor dismantling commencing in 2075 and lasting for 5 years. The volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2075. Uncertainty factors on Stock (upper): Arisings (upper) x 1.2 Х volumes: Arisings (lower) x 0.8 Stock (lower): **WASTE SOURCE** Mild steel items from the reactor structure. PHYSICAL CHARACTERISTICS General description: A variety of mild steel items. Mild steel items (100%). Physical components (%wt): Sealed sources: The waste does not contain sealed sources. Bulk density (t/m3): Comment on density: The density is of the waste as cut for packaging. CHEMICAL COMPOSITION Mild steel (100%). General description and components (%wt): Chemical state: Neutral Chemical form of H-3: The tritium is incorporated in the steel. radionuclides: C-14: The carbon-14 is incorporated in the steel. There also may be some contamination as graphite. Se-79: The selenium content is insignificant. Tc-99: Technetium will be incorporated in the steel. It is an activation product of Mo-98. Ra: The radium content is insignificant. Th: The thorium content is insignificant. U: The uranium content is insignificant. Np: The neptunium content is insignificant. Pu: The plutonium content is insignificant. All of the waste will be bulk metal items which will be cut for packaging. Metal thicknesses Metals and alloys (%wt): will probably range from a few mm to about 100 mm.

will probably range in	om a lew i	min to about 100 min.		
	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity	
Stainless steel	0			
Other ferrous metals	100.0	All of the waste included in this waste stream is mild steel.	100.0	
Iron				
Aluminium	0			
Beryllium				
Cobalt				

Copper	0		
Lead	0		
Magnox/Magnesium	. 0		
Nickel			
Titanium			
Uranium			
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	0	There are no "other" metals.	
Organics (%wt): None expected. The	ere are no	halogenated plastics or rubbers present.	
	(%wt)	Type(s) and comment	% of total C14
Total cellulosics	0		activity
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			
Oil or grease			
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen			
Others			
Other organics	0		
Other materials (%wt): Expect only graphite	€.		
		Type(a) and comment	% of total C14
	(%wt)	Type(s) and comment	% of total C14
Inorganic ion exchange materials	0		
Inorganic sludges and flocs	0		
Soil	0		
Brick/Stone/Rubble	0		
Cementitious material	0		
Sand			
Glass/Ceramics	0		
Graphite	TR		
Desiccants/Catalysts			

Asbestos	0	
Non/low friable		
Moderately friable		
Highly friable		
Free aqueous liquids	0	
Free non-aqueous liquids	0	
Powder/Ash	0	
Inorganic anions (%wt): There may be a trace	ce of chlori	de present.
	(%wt)	Type(s) and comment
Fluoride	0	
Chloride	TR	
lodide	0	
Cyanide	0	
Carbonate	0	
Nitrate	0	
Nitrite	0	
Phosphate	0	
Sulphate	0	
Sulphide	0	
		re or other non-radiological hazard have been identified
waste acceptance criteria:	o pose a n	re of other non-radiological nazard 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		
Putrescible wastes	0	
Non-putrescible wastes		
	^	
Corrosive materials	0	
Corrosive materials  Pyrophoric materials	0	
Pyrophoric materials	0	
Pyrophoric materials  Generating toxic gases  Reacting with water	0 0	
Pyrophoric materials  Generating toxic gases  Reacting with water  Higher activity particles  Soluble solids as bulk chemical	0 0	
Pyrophoric materials  Generating toxic gases  Reacting with water  Higher activity particles  Soluble solids as bulk chemical compounds	0 0	
Pyrophoric materials  Generating toxic gases  Reacting with water  Higher activity particles  Soluble solids as bulk chemical	0 0	
Pyrophoric materials  Generating toxic gases  Reacting with water  Higher activity particles  Soluble solids as bulk chemical compounds  Hazardous substances / None expected	0 0	Type(s) and comment

Benzene			
Chlorinated solvents			
Formaldehyde			
Organometallics			
Phenol			
Styrene			
Tri-butyl phosphate			
Other organophosphates			
Vinyl chloride			
Arsenic			
Barium			
Boron			
Boron (in Boral)			
Boron (non-Boral)			
Cadmium			
Caesium			
Selenium			
Chromium			
Molybdenum			
Thallium			
Tin			
Vanadium			
Mercury compounds			
Others			
Electronic Electrical Equipment (EEE)			
EEE Type 1			
EEE Type 2			
EEE Type 3			
EEE Type 4			
EEE Type 5			
agents (%wt): Yes			
	(%wt)	Type(s) and comment	
EDTA			
DPTA			
NTA			
NTA			
NTA Polycarboxylic acids	TR		

Potential for the waste to contain discrete items:

Complexing

Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs. NB If recycled then DI Limits  $\rm n/a$ 

#### 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		100.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		

Comment on planned treatments:

This waste stream is expected to be sent for Metal Recycle.

#### **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	100.0	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	%
Disposal Notice	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			

## Opportunities for alternative disposal routing:

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
_	_	_	_	_	<u>_</u>

Waste Packaging for Disposal: (Not applicable to this waste stream)

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			

Other information: -

Waste Planned for Disposal at the LLW Repository: (Not applicable to this waste stream)

Container voidage:

Waste Characterisation

Form (WCH):

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Waste consigned for disposal to LLWR in year of generation:

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. The 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:

The specific activities were estimated from neutron activation calculations of the material

and its impurities.

Other information: There may be some contamination by Cs137. The activities quoted are those at 85 years

after reactor shutdown, i.e. in 2075.

Nuclicide	sq/m³	tivity, TBq/m³	Mean radioa			tivity, TBq/m³	Mean radioac		
H 3 Be 10 C 14 Na 22 A 1.29E-04 C C 2 B		Future		Nuclida					Nuclida
Be 10 C14 Na 22 A126 C136 C136 C136 C136 C136 C137 Ba 10 C136 C136 C136 C136 C136 C136 C136 C136		arisings	1.4.2022 Code				22 Code	1.4.2022	
C 14	8					5.44E-06			
Na 22	8								
A1 26	8					1.29E-04			
C136	8								
Ar 39 Ar 42 K 40 Ca 41 Mn 53 Mn 53 Mn 54 Mn 54 Nn 55 Fe 55 Co 60 Ni 59 Ni 63 So 79 Kr 81 Kr 85 R 82 Se 79 Kr 81 Rr 82 Rr 82 Rb 87 Sr 90 Sr	8								
Ar 42	8					1.63E-08			
K 40 Ca 41 Mn 53 Mn 53 Mn 54 Fe 55 Co 60	8								
Ca 41 Mn 53 Mn 54 Mn 54 Fe 55 Co 60 1.55E-06 CC 2 Bi 208 Ni 59 Sa 43E-06 CC 2 Bi 200 Ni 63 Se 79 Se 8 Ra 223 Ra 8225 RK 81 Kr 85 RB 87 RB 87 RB 97 Sr 90 RV 90 RV 90 RV 90 RV 91 Nb 91 Nb 92 Nb 93 Nb 93 RD 94 RD 98 RD 97 RU 106 RD 98 RD 1.13E-07 RU 108 RD 1.13E-07 RU 108 RD 123 RD 119 RD 119 RD 1236 RD 1236 RD 1238 RD 1236 RD 1241 RD 1236 RD 1236 RD 1241 RD 1236 RD 1246 R	8								
Mn 53 Mn 54 Fe 55 Co 60 Ni 59 Ni 59 Ni 63 Se 79 Kr 81 Kr 81 Kr 85 Rr 85 Rb 87 Sr 90	8								
Mn 54	8								
Fe 55	8 8								
Co 60	8								
Ni 59 Ni 63 Ni 63 So 79 Ni 63 So 79 Kr 81 Kr 85 So 79 Kr 81 Kr 85 Nb 87 Sr 90 Zr 93 Nb 92 Nb 93 Nb 94 Nb 93 To 97 To 99 Ru 106 Pd 107 Ag 108m Pd 107 Ag 108m Pd 107 Ag 108m So 121m So 121m So 121m So 1225 Ru 106 Pd 107 Ag 108m So 121m So 1226 So 125 So 126 So 126 So 126 So 126 So 126 So 127 Sr 90 So 20 So	8					4 FFF 06			
Ni 63	8								
Zn 65   Se 79	8								
Se 79       8       Ra 225       Ra 226         Kr 81       8       Ra 226       Ra 226         Kr 85       8       Ra 228       Ra 228         Rb 87       8       Ac 227       Th 227         Sr 90       8       Th 227       Th 228         Nb 91       8       Th 229       Th 229         Nb 93m       1.4E-08       CC 2       Th 234         Mo 93       3.77E-06       CC 2       Th 234         Mo 93       3.77E-06       CC 2       U 231         Tc 97       8       Pa 233         Tc 99       8.74E-07       CC 2       U 232         Ru 106       8       U 234         Pd 107       8       U 234         Ag 110m       8       U 236         Cd 109       8       U 236         Cd 113m       8       Pu 236         Sn 121m       8       Pu 238         Sn 122       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Pu 242         Te 127m       8       Am 241         Te 127m       8 <td>8</td> <td></td> <td></td> <td></td> <td></td> <td>5.02E-04</td> <td></td> <td></td> <td></td>	8					5.02E-04			
Kr 81       8       Ra 226       Ra 228         Rb 87       8       Ac 227       From 127         Sr 90       8       Th 227       Th 227         Zr 93       8       Th 229       Th 228         Nb 91       8       Th 229       Th 230         Nb 93m       1.4E-08       CC 2       Th 232         Nb 93m       1.4E-08       CC 2       Th 234         Mo 93       3.77E-06       CC 2       Pa 231         Tc 97       8       Pa 233         Tc 99       8.74E-07       CC 2       U 232         Ru 106       8       U 233         Pd 107       8       U 234         Ag 108m       1.13E-07       CC 2       U 236         Ag 109m       1.13E-07       CC 2       U 236         Ag 109m       1.13E-07       CC 2       U 236         Np 234       U 236       U 238         Np 237       Pu 236       Pu 239         Sn 129m       8       Pu 239         Sn 126       8       Pu 241         Sb 126       8       Pu 241         Te 125m       8       Am 241         Te 127m       8       <	8								
Kr 85       Rb 87       8       Ra 228       Ac 227       From 227       From 227       From 227       From 227       From 228       From 228       From 228       From 228       From 228       From 229	8								
Rb 87 Sr 90 Zr 93 Nb 91 Nb 92 Nb 93m Nb 94 Mo 93 Tc 97 Tc 99 Ru 106 Pd 107 Ag 108m Ag 110m Cd 109 Cd 113m Sn 123 Sn 123 Sn 123 Sn 123 Sn 126 Sb 125 Sb 126 Te 125m Te 127m Te 127m Te 127 Ba 133 La 137 Experimental as a company Ba 128 Cm 244 Cs 137 Ba 133 La 137  Experimental as a company Experimental as	8								
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Nb 91 Nb 92 Nb 93m Nb 94 Nb 94 1.4E-08 CC 2 Th 234 Mo 93 Tc 97 Tc 97 Ru 106 Rd 107 Rd 108 Rd 11.3E-07 Rd 109 Cd 113m Sn 121m Sn 121m Sn 123 Sn 126 Sb 125 Sb 126 Tc 125m Tc 127 Tc 129 Ru 129 R	8								
Nb 92 Nb 93m Nb 94 1.4E-08 CC 2 Th 232 Nb 94 Mo 93 Tc 97 Tc 99 8.74E-07 CC 2 U 232 Ru 106 Pd 107 Ag 108m Ag 110m Cd 109 Cd 113m Sn 121m Sn 121m Sn 123 Sn 126 Sb 125 Sb 126 Te 125m Te 125m Te 125m Te 127m I 129 CS 134 CS 137 CS 137 CS 137 CS 138 CS 137 CS 137 CS 137 CS 128 CS 137 CS 128 CS 137 CS 137 CS 133 CS 133 CS 137 CS 133 CS 133 CS 133 CS 126 CS 133 CS 126 CS 133 CS 127 CS 128 CS 128 CS 128 CS 128 CS 127 CS 128 CS 128 CS 127 CS 128 CS 128 CS 127 CS 128 CS 128 CS 128 CS 127 CS 128 CS 128 CS 128 CS 128 CS 127 CS 128 CS	8								
Nb 93m Nb 94 Nb 94 Nb 93 S.77E-06 CC 2 Th 234 Nb 93 Tc 97 Tc 97 Ru 106 Ru 106 Ru 106 Ru 107 Ag 108m Ag 110m Cd 109 Cd 113m Sn 121m Sn 123 Sn 126 Sb 125 Sb 126 Tc 125m Tc 127m I 129 CS 134 CS 135 CS 137 Ba 133 La 137  Ti 97  Th 232 Th 234 Th 234 Te 22 Th 234 Th 232 Th 234 Ru 233 Ru 234 Ru 235 Ru 236 Ru 236 Ru 236 Ru 238 Ru 240 Ru 240 Ru 240 Ru 241 Ru 242 Ru 244 Ru 244 Ru 244 Ru 244 Ru 245 Ru 246 Ru 246 Ru 246 Ru 247 Ru 247 Ru 248 Ru	8								
Nb 94	8								
Mo 93       3.77E-06       CC 2       Pa 231         Tc 97       8       Pa 233         Tc 99       8.74E-07       CC 2       U 232         Ru 106       8       U 233         Pd 107       8       U 234         Ag 108m       1.13E-07       CC 2       U 235         Ag 110m       8       U 236         Cd 109       8       U 238         Cd 113m       8       Np 237         Sn 119m       8       Pu 236         Sn 121m       8       Pu 238         Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242         I 129       8       Am 243         Cs 134       8       Cm 242         Cs 135       6       Cm 244         Cs 137       6       Cm 245         Ba 133       Cm 245       Cm 246	8					1 45 09			
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Cd 109       8       U 238         Cd 113m       8       Np 237         Sn 119m       8       Pu 236         Sn 121m       8       Pu 239         Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 243         Cs 134       8       Cm 242         Cs 135       8       Cm 243         Cs 137       8       Cm 244         Ba 133       8       Cm 245         La 137       8       Cm 246	8				i	1.102 07			-
Cd 113m       8       Np 237         Sn 119m       8       Pu 236         Sn 121m       8       Pu 238         Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       Cm 242       Cm 242         Cs 135       Cm 243       Cm 243         Cs 137       6       Cm 244         Ba 133       Cm 246       Cm 246         La 137       8       Cm 246	8								_
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Sn 121m       8       Pu 238         Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       Cm 242       Cm 242         Cs 135       Cm 243       Cm 243         Cs 137       6       Cm 244         Ba 133       Cm 245       Cm 246         La 137       8       Cm 246	8			Pu 236					
Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       Cm 242       Cm 242         Cs 135       Cm 243       Cm 243         Cs 137       6       Cm 244         Ba 133       Cm 245       Cm 246         La 137       8       Cm 246	8			Pu 238					
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Te 127m  I 129  S	8			Am 241					
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Cs 135 Cs 137 Ba 133 La 137  S	8				8				
Ba 133	8				8				
La 137 8 Cm 246	8				6				Cs 137
	8				8				Ba 133
0 Cm 248	8				8				La 137
24 100	8			Cm 248	8				La 138
Ce 144 8 Cf 249	8				8				
Pm 145 8 Cf 250	8				8				Pm 145
Pm 147 8 Cf 251	8				8				Pm 147
Sm 147 8 Cf 252	8				8				Sm 147
Sm 151 8 Other a									Sm 151
Eu 152 1.63E-08 CC 2 Other b/g				_	CC 2	1.63E-08			Eu 152
Eu 154 8 Total a 0	0								
Eu 155 8 <b>Total b/g 0 6.51</b>	-04 CC 2	6.51E-04	0	Total b/g	8				Eu 155

## 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

Bands quantify uncertainty in mean radioactivity.

## Code

- 1 Measured activity
- 2 Derived activity (best estimate)
  3 Derived activity (upper limit)

- A Not present
   Foresent but not significant
   Likely to be present but not assessed
   Present in significant quantities but not determined
   Not expected to be present in significant quantity