

<b>WASTE STREAM</b>	<b>9J948</b>	<b>Reactor and Auxiliary Building LLW</b>
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**SITE** Hunterston A

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** LLW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	19.2 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2023.....	4.0 m <sup>3</sup>
	1.4.2023 - 31.3.2024.....	7.0 m <sup>3</sup>
	1.4.2024 - 31.3.2025.....	5.0 m <sup>3</sup>
	1.4.2025 - 31.3.2026.....	12.0 m <sup>3</sup>
	1.4.2026 - 31.3.2030.....	105.6 m <sup>3</sup>
Total future arisings:		133.6 m <sup>3</sup>
Total waste volume:		152.8 m <sup>3</sup>

Comment on volumes: Waste volumes include a proportion of secondary waste arisings.

Uncertainty factors on volumes:

Stock (upper):	x 1.2	Arisings (upper)	x 1.2
Stock (lower):	x 0.8	Arisings (lower)	x 0.8

**WASTE SOURCE** Waste arising from the reactor and auxiliary buildings during Care and Maintenance Preparation.

**PHYSICAL CHARACTERISTICS**

General description: This waste stream consists of waste arising's from areas associated with the Reactor buildings and the auxiliary buildings. The waste is described as general waste, mostly comprising of metals including miscellaneous plant items and concrete. Additionally it includes secondary LLW wastes including those associated with SAWBR waste processing.

Physical components (%vol): Mild Steel Items [Motors, duct, machine parts] (73%), stainless steel (4%) plastic (4%), paper/cotton (4%) contaminated concrete/soil (7%), wood (~2%), aluminium (<1%), Asbestos Contaminated Items (6%)

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~0.4

Comment on density: The average waste density is approximately 0.4 t/m<sup>3</sup>. However some items within the waste are likely to be of higher density, 0.6-1.0 t/m<sup>3</sup>.

**CHEMICAL COMPOSITION**

General description and components (%wt): Metal (~73%), concrete/rubble (3%), Soil (3%), Biodegradable (non-putrescibles) (4%), plastics (non-halogenated) (4%), Wood (2%), Other organic (5%) and asbestos (6%).

Chemical state: Neutral

Chemical form of radionuclides:

- H-3: Tritium may be present as tritiated water.
- C-14: The chemical form of carbon 14 may be graphite.
- Cl-36: The chemical form of chlorine 36 has not been determined.
- Se-79: The chemical form of selenium has not been determined.
- Tc-99: The chemical form of technetium has not been determined.
- Ra: The radium isotope content is insignificant.
- Th: The thorium isotope content is insignificant.
- U: The uranium isotope content is insignificant.
- Np: Neptunium isotope content is expected to be insignificant.
- Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): This waste stream will contain waste of various sizes and thicknesses.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....			
Other ferrous metals.....	72.4	Steel: 71.11% iron, 0.74% chromium and 0.56% Nickel	
Iron.....			
Aluminium.....	0.45	Items e.g framework and shelving etc.	
Beryllium.....	0		
Cobalt.....			
Copper.....	0.23	Items e.g pipework and fittings	
Lead.....	0.88	Items e.g pipework and flashings	
Magnox/Magnesium.....	0		
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	NE	"Other" metals have not been estimated.	

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	~6.0		
Paper, cotton.....	4.0		
Wood.....	~2.0		
Halogenated plastics .....	0		
Total non-halogenated plastics.....	~4.0		
Condensation polymers.....	0		
Others.....	~4.0	Items e.g fittings and brackets	
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.....	5.0		

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.....	~3.0			
Brick/Stone/Rubble.....	~3.0			
Cementitious material.....	0			
Sand.....				
Glass/Ceramics.....	0			
Graphite.....	0			
Desiccants/Catalysts.....				
Asbestos.....	6.0			
Non/low friable.....	4.6	chrysotile (white)		
Moderately friable.....	1.4	chrysotile (white)		
Highly friable.....	0			
Free aqueous liquids.....	0			
Free non-aqueous liquids.....	0			
Powder/Ash.....	0			

Inorganic anions (%wt):      No cyanides are expected, otherwise the inorganic anion content of the waste is not estimated.

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

Materials of interest for waste acceptance criteria:      None expected as efforts are made to remove all hazardous materials during sorting, however some asbestos is expected to be 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	

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Non-putrescible wastes.....		
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	P	surface area of Aluminium 1500000cm2.
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances /  
non hazardous pollutants:      None expected

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....	0	
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.....		

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Complexing agents (%wt):

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	NE	

Potential for the waste to contain discrete items: Not yet determined. In & of itself not a DI; waste stream may include DIs (notably any stainless steel components)

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		8.0
Solidification		
Decontamination		
Metal treatment		10.0
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		82.0

Comment on planned treatments:

82% to landfill as VLLW

**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	82.0	0.40
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	8.0	0.40
Expected to be consigned to a Metal Treatment Facility	10.0	1.4
Expected to be consigned as Out of Scope		
Expected to be recycled / reused		
Disposal route not known		

Classification codes for waste expected to be consigned to a landfill facility: 17 04 05, 17 04 07, 17 06 01\*

**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:** (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): -

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: -

Uncertainty: Activity values are current best estimates. Specific activity is a function of Station operating history. The values quoted are indicative of the activities that would be expected.

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 have been estimated from the waste stream fingerprint. 1MXN-3HUA-0-WCH-0-4542 decayed by seven years to 01/04/2022

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	3.84E-07	CC 2	3.84E-07	CC 2	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	9.75E-09	CC 2	9.75E-09	CC 2	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36	1.64E-07	CC 1	1.64E-07	CC 1	Lu 174		8		8
Ar 39		8		8	Lu 176		8		8
Ar 42		8		8	Hf 178n		8		8
K 40		8		8	Hf 182		8		8
Ca 41		8		8	Pt 193		8		8
Mn 53		8		8	Tl 204		8		8
Mn 54		8		8	Pb 205		8		8
Fe 55		8		8	Pb 210		8		8
Co 60	3.1E-09	CC 2	3.1E-09	CC 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	9.4E-09	CC 1	9.4E-09	CC 1	Po 210		8		8
Zn 65		8		8	Ra 223		8		8
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226		8		8
Kr 85		8		8	Ra 228		8		8
Rb 87		8		8	Ac 227		8		8
Sr 90	3.77E-09	CC 1	3.77E-09	CC 1	Th 227		8		8
Zr 93		8		8	Th 228		8		8
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230		8		8
Nb 93m		8		8	Th 232		8		8
Nb 94		8		8	Th 234		8		8
Mo 93		8		8	Pa 231		8		8
Tc 97		8		8	Pa 233		8		8
Tc 99		8		8	U 232		8		8
Ru 106		8		8	U 233		8		8
Pd 107		8		8	U 234		8		8
Ag 108m		8		8	U 235		8		8
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238		8		8
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238		8		8
Sn 123		8		8	Pu 239		8		8
Sn 126		8		8	Pu 240		8		8
Sb 125		8		8	Pu 241	2.29E-09	CC 1	2.29E-09	CC 1
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241		8		8
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134		8		8	Cm 242		8		8
Cs 135		8		8	Cm 243		8		8
Cs 137	1.21E-09	CC 2	1.21E-09	CC 2	Cm 244		8		8
Ba 133		8		8	Cm 245		8		8
La 137		8		8	Cm 246		8		8
La 138		8		8	Cm 248		8		8
Ce 144		8		8	Cf 249		8		8
Pm 145		8		8	Cf 250		8		8
Pm 147		8		8	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151	1.09E-08	CC 2	1.09E-08	CC 2	Other a				
Eu 152	2.54E-09	CC 2	2.54E-09	CC 2	Other b/g				
Eu 154		8		8	<b>Total a</b>	<b>0</b>		<b>0</b>	
Eu 155		8		8	<b>Total b/g</b>	<b>5.91E-07</b>	<b>CC 2</b>	<b>5.91E-07</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