

WASTE STREAM	2C921	Ponds LLW
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SITE Chapelcross
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.....	0 m ³
Future arisings -	1.4.2022 - 31.3.2026.....	2159.6 m ³
Total future arisings:		2159.6 m ³
Total waste volume:		2159.6 m ³
Comment on volumes:	The four reactors at Chapelcross ceased generating in the period from August 2001 (R1) to February 2004 (R2).	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.2
	Stock (lower): x	Arisings (lower) x 0.8

WASTE SOURCE Much of this waste stream is metallic waste and building material concrete arising from the main pond building. Wastes also include non-compactable plant from the decontamination centre, active workshop flask cleaning area and pond corridors. There will be some secondary waste from these areas.

PHYSICAL CHARACTERISTICS

General description: The waste includes items such as pumps, motors, cranes, roller systems, skip handling equipment, and waste from the ponds building that is predominantly soft waste. This includes items such as used personal protective equipment, polythene sheeting, disposable wipes/swabs, rubber, PVC and tape. Bulk metallic waste items are also included in this waste stream, this is in the form Flask Vat (Washdown) Tanks. The waste normally contains no free liquid, as the excess liquid is drained and returned to the pond before packaging the waste. Asbestos is also present in the waste stream in the form of gaskets/ropes incorporated into joint, pipework and redundant machinery. These items contain Chrysotile type asbestos. As decommissioning progresses there will be quantities of concrete rubble and soil generated. Any lead included in this waste stream will take the form of lead sheeting.

Physical components (%wt): Metal (~67%), incinerables (plastic non halogenated (~7%), rubber (~7%), wood (~7%), biodegradable (Non-putrescible) (~7%), concrete/rubble (~2%) & soil (~2%), others (1%)/ 'Others' accounts for Asbestos cement sheeting, insulation material and gaskets/ropes incorporated into joint, pipeworks and redundant machinery. Note this will be estimated 0.1% but has been included as minimum within the table above. 1% has therefore been deducted from metal as the gaskets would form part of this total.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.7

Comment on density: Density of 0.7t/m³ is an initial estimate subject to confirmation.

CHEMICAL COMPOSITION

General description and components (%wt): Metal (~67%), incinerables (plastic non halogenated (~7%), rubber (~7%), wood (~7%), biodegradable (Non-putrescible) (~7%), concrete/rubble (~2%) & soil (~2%), others (1%). 'Others' accounts for Asbestos cement sheeting, insulation material and gaskets/ropes incorporated into joint, pipeworks and redundant machinery. Note this will be estimated 0.1% but has been included as minimum within the table above. 1% has therefore been deducted from metal as the gaskets would form part of this total.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: The chemical form of tritium has not been determined.
C-14: The chemical form of carbon 14 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: Radium isotope content is expected to be insignificant.
Th: The thorium content is insignificant.
U: Uranium isotope content is expected to be insignificant.

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Np: Neptunium isotope content is expected to be insignificant.
 Pu: 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.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....	~67.7	Deplanted bulk items i.e. Flask Vats (Washdown tanks), rail bogies, flask transport trailer. Tooling and equipment, pumps/motors, pipework, ducting.	
Iron.....			
Aluminium.....	0.41	Scaffolding poles	
Beryllium.....	NE		
Cobalt.....			
Copper.....	TR		
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....			
Titanium.....			
Uranium.....	NE		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	NE		

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	7.0		
Paper, cotton.....	0		
Wood.....	~7.0		
Halogenated plastics	0		
Total non-halogenated plastics.....	~7.0	Soft waste including polythene sheeting, gloves, PPE, tape	
Condensation polymers.....	~3.5		
Others.....	~3.5		
Organic ion exchange materials....	0		
Total rubber.....	~7.0		
Halogenated rubber	~3.5		
Non-halogenated rubber.....	~3.5		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			

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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.....	~2.0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	~2.0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	0.12		
Non/low friable.....	0.12	Asbestos gaskets in pipework flanges and redundant equipment, chrysotile (white)	
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): -

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

Materials of interest for waste acceptance criteria: -

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	

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Biodegradable materials.....	7.0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	7.0	
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	P	383.35m2
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / non hazardous pollutants: Asbestos (inconsequential quantity). Trace amounts of Permobel Epoxy Shop Primer, Permobel Epoxy Finisher and SAKAPHEN Si 14E Heat Cured Durablast in the form of Dried Paint/Surface Coating - Epoxy Resin Zinc Chromate Primer (Coating on Flask Vat Tanks).

	(%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.....	P	10 off pumps, weight = 100kg
EEE Type 3.....	P	7 off motors, weight = 66.6kg

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EEE Type 4.....

EEE Type 5.....

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: No. 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	Off-site	~25.0
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination	Off-site	~10.0
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		~65.0

Comment on planned treatments:

50% of the stream is expected to be disposed of as VLLW to landfill

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	15.0	0.70
Expected to be consigned to a Landfill Facility	50.0	0.70
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	25.0	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 02 01, 17 02 03, 17 06 01*

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

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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			

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 ³	Number of packages
1/3 Height IP-1 ISO	~15.0	~10	33
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:

Container voidage: -

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste has a current WCH.
Inventory information is consistent with the current 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: Activation and contamination of materials.

Uncertainty: Activity values are current best estimates. Specific activity is a function of operating history. The values 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'.

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Measurement of
radioactivities:

activity data taken from 1MXN-1CHA-0-WCH-0-4199 V9 decayed five years to 2022 (start
of first arising) from 2017 activity reference date.

Other information:

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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			6.43E-07	CC 1	Gd 153				8
Be 10				8	Ho 163				8
C 14			1.04E-06	CC 1	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			6.6E-09	CC 1	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41				8	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55			2.75E-07	CC 1	Pb 210				8
Co 60			2.36E-07	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			1.71E-07	CC 1	Po 210				8
Zn 65				8	Ra 223				8
Se 79				8	Ra 225				8
Kr 81				8	Ra 226				8
Kr 85				8	Ra 228				8
Rb 87				8	Ac 227				8
Sr 90			6.14E-06	CC 1	Th 227				8
Zr 93				8	Th 228		8.75E-09	CC 2	8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m				8	Th 232				8
Nb 94				8	Th 234		2.09E-09	CC 2	8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			9.31E-09	CC 1	U 232		1.03E-08	CC 1	8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m				8	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238		2.09E-09	CC 1	8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		1.38E-07	CC 1	8
Sn 123				8	Pu 239		1.81E-07	CC 1	8
Sn 126				8	Pu 240		2.23E-07	CC 1	8
Sb 125			3.1E-09	CC 2	Pu 241		4.4E-06	CC 1	8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241		1.03E-06	CC 1	8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134			2.63E-09	CC 2	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137			1.58E-05	CC 2	Cm 244		5.57E-09	CC 1	8
Ba 133			1.44E-08	CC 2	Cm 245				8
La 137				8	Cm 246				8
La 138				8	Cm 248				8
Ce 144				8	Cf 249				8
Pm 145				8	Cf 250				8
Pm 147			7.36E-09	CC 1	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151			1.18E-07	CC 1	Other a				8
Eu 152			1.79E-09	CC 2	Other b/g				8
Eu 154			2.82E-08	CC 2	Total a	0	1.60E-06	CC 1	8
Eu 155			6.99E-09	CC 2	Total b/g	0	2.89E-05	CC 1	8

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