

WASTE STREAM	9H323	Pile Cap, Dry Fuel Store and Associated Areas LLW
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SITE Wylfa
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 -	1.4.2101 - 31.3.2106.....	683.3 m ³
Total future arisings:		683.3 m ³
Total waste volume:		683.3 m ³
Comment on volumes:	Final Dismantling & Site Clearance is assumed to commence in 2097 with reactor dismantling commencing in 2101 and lasting for 5 years. The volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2100.	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.2
	Stock (lower): x	Arisings (lower) x 0.8

WASTE SOURCE Waste which has been deferred from Care and Maintenance preparation scope in the areas covered by this waste stream.

PHYSICAL CHARACTERISTICS

General description: Hard trash and redundant equipment. Mainly steel components. No large items are expected.

Physical components (%wt): Metal (85%), Concrete/rubble (1%), Soil (1%), Biodegradable non-putrescibles (3%), Plastics halogenated (1%), plastics non-halogenated (1%), Rubber (1%), Wood (1%), Other organic (2%), Others including asbestos (4%)

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 1.01

Comment on density: Density is based on the WCH mass divided by volume

CHEMICAL COMPOSITION

General description and components (%wt): Metal (85%), Concrete/rubble (1%), Soil (1%), Biodegradable non-putrescibles (3%), Plastics halogenated (1%), plastics non-halogenated (1%), Rubber (1%), Wood (1%), Other organic (2%), Others including asbestos (4%)

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.
 Cl-36: Chlorine 36 is expected to be insignificant.
 Se-79: The selenium content is insignificant.
 Tc-99: The technetium content is insignificant.
 Ra: Radium isotope content is expected to be insignificant.
 Th: The thorium content is insignificant.
 U: Uranium isotope content is expected to be insignificant.
 Np: The neptunium content is insignificant.
 Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Metal thicknesses will be variable from about 1 mm up to about 30 mm.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	29.1	Assorted stainless steel. Metal (pipework, valves, filters, bearings, misc).	
Other ferrous metals.....	54.6	Drums, tooling, pipework, valves, filters, misc.	
Iron.....			

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Aluminium.....	0.50	Pipework, valves, filters, misc. contaminated dummy magnox alloy fuel elements (0.4 kg of 50kg magnox alloy).
Beryllium.....	TR	0.002 kg of 50 kg magnox alloy dummy fuel elements.
Cobalt.....		
Copper.....	0.10	Cable and WEEE.
Lead.....	0.01	Light bulbs (<1m3), lead shot.
Magnox/Magnesium.....	0.01	49.6 kg of 50 kg Magnox alloy dummy fuel elements.
Nickel.....		
Titanium.....	0.45	Miscellaneous
Uranium.....		
Zinc.....	0.50	Tooling, scaffolding, buckets, and a minor amount of mangnox dummy fuel elements.
Zircaloy/Zirconium.....	0	
Other metals.....	0	

Organics (%wt): Cellulosic materials expected. Halogenated plastics and rubbers are expected.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	1.0		
Paper, cotton.....	0		
Wood.....	1.0		
Halogenated plastics	0.72	Liners, lab waste/packaging.	
Total non-halogenated plastics.....	0.71	Lab waste/packaging.	
Condensation polymers.....	0.71	Lab waste/packaging.	
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	1.0		
Halogenated rubber	TR		
Non-halogenated rubber.....	1.0		
Hydrocarbons.....	0.50		
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...	0.50	Flooring	
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	2.0		

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.....	0.10		
Soil.....	1.0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	1.0		
Sand.....			
Glass/Ceramics.....	0.50	fibreglass lagging	
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	3.0		
Non/low friable.....	1.0	Equal portions of white/brown/blue asbestos assumed. Lagging.	
Moderately friable.....	1.0	Equal portions of white/brown/blue asbestos assumed. Asbestos contaminated plant items and gaskets.	
Highly friable.....	1.0	Equal portions of white/brown/blue asbestos assumed. Insulating boards.	
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): None expected.

	(%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	

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Biological etc. materials.....	0	
Biodegradable materials.....	3.0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	3.0	
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	P	1140m2
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / None expected
non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....	TR	in light bulbs (<1m3)
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....		
Caesium.....		
Selenium.....		
Chromium.....		
Molybdenum.....		
Thallium.....		
Tin.....	0.10	Paint tins
Vanadium.....		
Mercury compounds.....		
Others.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	P	20 items - mixture of VDU, electronic circuit boards, fans that have been stripped from control panels and telephones.
EEE Type 2.....		

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EEE Type 3..... P 10 items - corded drills
 EEE Type 4..... P 50 items 0 mainly fluorescent light tubes
 EEE Type 5.....

Complexing agents (%wt): Yes

(%wt) Type(s) and comment

EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants..... TR Citrates (decon-90) and Phosphoric acid (jenolite/Kamco)
 Total complexing agents..... TR

Potential for the waste to contain discrete items: Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; All stainless items assumed DIs. NB if recycled then DI Limits n/a. Insulation - In & of itself not a DI; waste stream may include DIs (Stainless items). If LLW thLarge Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; All stainless items assumed DIs. NB if recycled then DI Limits n/a. Insulation - In & of itself not a DI; waste stream may include DIs (Stainless items). If LLW then assumed drummed (ungrouted) & compacted so NOT DI (unless drums are grouted instead).

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	Off-site	5.0
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None	7.0	

Comment on planned treatments:

2% VLLW to landfill and 5% direct to LLWR so no treatment.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	10.0	1.0
Expected to be consigned to a Landfill Facility	2.0	
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	48.0	
Expected to be consigned to a Metal Treatment Facility	40.0	
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):

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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			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO	5.0	21.6	2
1/2 Height IP-2 Disposal/Re-usable ISO	5.0	10	4
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: Data have been presented as though the waste will be in dedicated containers. It is likely that this waste will be placed in containers with other waste. The WAMAC container loading volume of 21.6m³ is calculated based on the fact that ordinarily you can fit 36 (200 litre/0.2m³) drums (7.2m³) into a ½ height ISO, each drum can be compacted to a 1/3 of its original volume so therefore we can get 3 x the amount of un-compacted drums into the final disposal container (21.6m³)

Waste Planned for Disposal at the LLW Repository:

Container voidage: Significant in-accessible voidage is not expected.

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: The timing of consignment of the waste for disposal cannot be determined at present.

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

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Source:	Activation and contamination of materials.
Uncertainty:	Activity estimates are as shown in the radionuclide table.
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:	Activity data has been taken from parent stream 9H911 WCH - 1MXN-3WYL-0-WCH-4605 v3 decayed to 2100 - 79 years from activity ref date to take it to 85 years post shutdown as per other FSC streams.
Other information:	The activities quoted are those at 85 years after reactor shutdown, i.e. in 2100. There may be some contamination by Cs137. It is expected that the Waste will become Out of Scope at FSC

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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			1.69E-04	CC 1	Gd 153				8
Be 10				8	Ho 163				8
C 14			4.65E-06	CC 1	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			1.76E-06	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			9.17E-09	CC 2	Pb 205				8
Fe 55			9.1E-05	CC 1	Pb 210				8
Co 60			2.59E-05	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			3.49E-06	CC 1	Po 210				8
Zn 65			5.92E-09	CC 2	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			1.4E-08	CC 1	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m				8	Th 232				8
Nb 94			1.6E-08	CC 2	Th 234				8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106			5.69E-09	CC 2	U 233				8
Pd 107				8	U 234				8
Ag 108m			3.7E-08	CC 2	U 235				8
Ag 110m			2.8E-09	CC 2	U 236				8
Cd 109				8	U 238				8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		4.5E-09	CC 1	
Sn 123				8	Pu 239		4.9E-09	CC 1	
Sn 126				8	Pu 240		6.4E-09	CC 1	
Sb 125			1.27E-08	CC 2	Pu 241		4.76E-07	CC 1	
Sb 126				8	Pu 242			8	
Te 125m				8	Am 241		2.1E-08	CC 1	
Te 127m				8	Am 242m			8	
I 129				8	Am 243			8	
Cs 134			3.35E-08	CC 2	Cm 242			8	
Cs 135				8	Cm 243			8	
Cs 137			3.89E-07	CC 2	Cm 244			8	
Ba 133			2.13E-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			1.78E-08	CC 1	Cf 251			8	
Sm 147				8	Cf 252			8	
Sm 151				8	Other a				
Eu 152			4.64E-08	CC 2	Other b/g				
Eu 154			1.38E-07	CC 2	Total a	0	3.68E-08	CC 2	
Eu 155			4.58E-08	CC 2	Total b/g	0	2.97E-04	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