

WASTE STREAM	9F324	Reactor Area LLW/VLLW
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SITE Sizewell 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.....	0 m ³
Future arisings -	1.4.2092 - 31.3.2095.....	949.4 m ³
Total future arisings:		949.4 m ³
Total waste volume:		949.4 m ³
Comment on volumes:	Final Dismantling & Site Clearance is assumed to commence in 2088 with reactor dismantling commencing in 2092 and lasting for three years. Volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2091.	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.2
	Stock (lower): x	Arisings (lower) x 0.8

WASTE SOURCE Final Site Clearance and procedures in the areas covered by this waste stream.

PHYSICAL CHARACTERISTICS

General description: Hard and soft trash. All large items which cannot be cut to fit standard packages are disposed of in half height ISO containers.

Physical components (%vol): Metal (~48%vol), plastic (21%vol), rubber/paper/wood (4%vol), concrete/rubble (<1%vol) and insulation materials (~26%vol).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~4.61

Comment on density: Density based on typical weight of a 200 litre drum or half height ISO container weight/volume. Bulk density has been based on the assumed density of asbestos as 0.24 t/m³, concrete 2.4 t/m³, lead 11 t/m³, metal 7.9 t/m³, plastic 1.3 t/m³, and wood 0.5 t/m³

CHEMICAL COMPOSITION

General description and components (%wt): The waste comprises metals, mainly steel, various plastics including polythene, rubber, paper and components: Metal (~48%vol), plastic (~21%vol), wood (<1%vol), concrete/rubble (<1%vol), Rubber/Paper (<3%) and insulation materials (~26%vol).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium may be present as surface contamination of waste by tritiated liquor.
 C-14: Chemical form of carbon 14 may be contamination in the form of graphite dust.
 Cl-36: Chlorine 36 may be present as a contaminant of graphite dust.
 Se-79: The selenium 79 content is insignificant.
 Tc-99: The technetium-99 content is insignificant.
 Ra: The radium isotope content is insignificant.
 Th: The thorium content is insignificant.
 U: The chemical form of uranium isotopes has not been determined but may be uranium oxides.
 Np: The neptunium isotope content is insignificant.
 Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): 200 litre steel drums have a wall thickness of about 1mm.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~24.0	Generally 300 series stainless steels.	
Other ferrous metals.....	~24.0	Generally carbon steel	
Iron.....			
Aluminium.....	TR		

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Beryllium.....	0	
Cobalt.....		
Copper.....	TR	
Lead.....	<0.01	
Magnox/Magnesium.....	0	
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....	0	
Zircaloy/Zirconium.....	0	
Other metals.....	0	"Other" metals have not been identified.

Organics (%wt): The waste contains cellulose in the form of wood (~0.01%vol). Halogenated plastics and rubbers are expected.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	~2.0		
Paper, cotton.....	~1.0		
Wood.....	~1.0		
Halogenated plastics	~11.0		
Total non-halogenated plastics.....	~10.0		
Condensation polymers.....	0		
Others.....	10.0		
Organic ion exchange materials....	0		
Total rubber.....	2.0		
Halogenated rubber	~1.0		
Non-halogenated rubber.....	~1.0		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	TR		

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	<0.50		
Cementitious material.....	<0.50		
Sand.....			

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Glass/Ceramics.....	0	
Graphite.....	0	
Desiccants/Catalysts.....		
Asbestos.....	26.0	unknown what type at this stage
Non/low friable.....		
Moderately friable.....		
Highly friable.....		
Free aqueous liquids.....	0	
Free non-aqueous liquids.....	0	
Powder/Ash.....	0	

Inorganic anions (%wt): None expected, but possibly present in trace quantities.

	(%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: -

	(%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	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

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Hazardous substances / non hazardous pollutants: Asbestos is also expected to arising as part of this waste stream. It has been assumed that 100% of the insulation material contains asbestos.

	(%wt)	Type(s) and comment
Acrylamide.....		
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.....		

Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	0	

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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 then assumed drummed (ungroued) & 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		
Supercompaction (HFC)		
Incineration		16.0
Solidification		
Decontamination		
Metal treatment		27.0
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		57.0

Comment on planned treatments:

-

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	57.0	
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	16.0	
Expected to be consigned to a Metal Treatment Facility	27.0	
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 02 03, 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			

Opportunities for alternative disposal routing: -

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

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

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			
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: Activation and contamination of materials.

Uncertainty: All of the waste will fall into the LLW category. The activity values quoted are the current best estimates.

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 equivalent operational waste stream and decayed until the arising date.

Other information: The activities quoted are those at 85 years after reactor shutdown, i.e. in 2091 There may be some contamination by Cs137.

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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			3.65E-06	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			3.33E-06	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			1.43E-06	CC 2	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			7.76E-14	CC 2	Pb 210				8
Co 60			2.76E-10	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			5.4E-07	CC 2	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			1.49E-08	CC 2	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			4.63E-09	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				8	U 233				8
Pd 107				8	U 234		3.32E-09	CC 2	8
Ag 108m				8	U 235				8
Ag 110m				8	U 236		1.77E-09	CC 2	8
Cd 109				8	U 238		3.32E-09	CC 2	8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238				8
Sn 123				8	Pu 239				8
Sn 126				8	Pu 240				8
Sb 125			1.99E-17	CC 2	Pu 241		3.18E-09	CC 2	8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241		3.52E-09	CC 2	8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134			1E-19	CC 2	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137			9.35E-09	CC 2	Cm 244				8
Ba 133			4.32E-11	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			2.49E-17	CC 2	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				
Eu 152			2.75E-10	CC 2	Other b/g				
Eu 154			1.01E-10	CC 2	Total a	0	1.19E-08	CC 2	
Eu 155			4.85E-13	CC 2	Total b/g	0	8.98E-06	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