

<b>WASTE STREAM</b>	<b>9B105</b>	<b>Care and Maintenance LLW</b>
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**SITE** Bradwell

**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.....	11.0 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2030.....	22.4 m <sup>3</sup>
	1.4.2030 - 31.3.2040.....	28.0 m <sup>3</sup>
	1.4.2040 - 31.3.2070.....	84.0 m <sup>3</sup>
	1.4.2070 - 31.3.2087.....	47.6 m <sup>3</sup>
Total future arisings:		182.0 m <sup>3</sup>
Total waste volume:		193.0 m <sup>3</sup>
Comment on volumes:	Bradwell entered C&M during 2018 however this stream only started to arise during 2019. There are 104 drums in stock assumed to be approximately half full. Arisings are assumed at a nominal 2.8m3 per year of C&M.	
Uncertainty factors on volumes:	Stock (upper): x 1.1	Arisings (upper) x 1.2
	Stock (lower): x 0.9	Arisings (lower) x 0.8

**WASTE SOURCE** Wastes from the safe store and Interim Storage Facility (ISF) during the Care and Maintenance period

**PHYSICAL CHARACTERISTICS**

General description: Principally secondary waste arisings, including mixed plastic sheeting, wipes, and protective clothing. There will be some secondary waste arisings potentially contaminated with asbestos or drain sludge.

Physical components (%wt): Principally plastic and cloth (95%wt), others (5%wt).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~0.188

Comment on density: The density is an estimate based on 1 x bag weighing 15kg and holding 80 litres of waste.

**CHEMICAL COMPOSITION**

General description and components (%wt): Principally plastic and cloth (95 %wt), others (5 %wt).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium present as surface contamination of waste by tritiated liquor.  
C-14: Contamination in the form of graphite dust.  
Cl-36: Chlorine 36 may be present as a contaminant of graphite dust.  
Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	5.0		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....			
Copper.....	0		

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Lead.....	0
Magnox/Magnesium.....	0
Nickel.....	
Titanium.....	
Uranium.....	
Zinc.....	0
Zircaloy/Zirconium.....	0
Other metals.....	0

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~25.0		
Paper, cotton.....	~24.0		
Wood.....	~1.0		
Halogenated plastics .....	~24.0		
Total non-halogenated plastics.....	~46.0		
Condensation polymers.....	0		
Others.....	~46.0		
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): -

	(%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		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	0		

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Non/low friable.....

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..... 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

Biological etc. materials..... 0

Biodegradable materials..... 0

Putrescible wastes..... 0

Non-putrescible wastes..... 0

Corrosive materials..... 0

Pyrophoric materials..... 0

Generating toxic gases..... 0

Reacting with water..... 0

Higher activity particles..... 0

Soluble solids as bulk chemical compounds..... 0

Hazardous substances / non hazardous pollutants: None expected

(%wt) Type(s) and comment

Acrylamide.....

Benzene.....

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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.....

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. n/a, DI concept applies only to Disposal at LLWR; by definition LLWR will not accept materials suitable for Incineration which accounts for 99% of the stream.

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**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 Size reduction Decay storage Recycling / reuse Other / various None	Off-site	~99.0
		<1.0

Comment on planned treatments:

Waste is expected to be transferred to Sizewell A Site for streaming, processing and packaging for disposal

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	<1.0	0.19
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	~99.0	0.19
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		

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 %		
	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:**

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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	<1.0	~10	< 1

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 does not have a current WCH.

Waste consigned for disposal to LLWR in year of generation: No. Timing of disposal is not yet known

**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: Contamination of materials.

Uncertainty: Activity values are current best estimates. Specific activity is a function of site 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 developed using 9B910 and 9B951 as the basis with a suitable decay period to the beginning of Care and Maintenance

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	5.96E-07	CC 2	5.96E-07	CC 2	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	9.8E-07	CC 2	9.8E-07	CC 2	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36	2.78E-07	CC 2	2.78E-07	CC 2	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	4.11E-06	CC 2	4.11E-06	CC 2	Pb 210		8		8
Co 60	5.05E-06	CC 2	5.05E-06	CC 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	1.59E-06	CC 2	1.59E-06	CC 2	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	1.81E-05	CC 2	1.81E-05	CC 2	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	4.82E-08	CC 2	4.82E-08	CC 2	Th 234	1.46E-08	CC 2	1.46E-08	CC 2
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	6.62E-09	CC 2	6.62E-09	CC 2
Ag 108m	3.89E-08	CC 2	3.89E-08	CC 2	U 235		8		8
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238	1.46E-08	CC 2	1.46E-08	CC 2
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	9.61E-06	CC 2	9.61E-06	CC 2
Sn 123		8		8	Pu 239	1.47E-06	CC 2	1.47E-06	CC 2
Sn 126		8		8	Pu 240	1.92E-06	CC 2	1.92E-06	CC 2
Sb 125	5.65E-09	CC 2	5.65E-09	CC 2	Pu 241	2.8E-05	CC 2	2.8E-05	CC 2
Sb 126		8		8	Pu 242		8		8
Te 125m	1.41E-09	8	1.41E-09	8	Am 241	7.76E-06	CC 2	7.76E-06	CC 2
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134	6.17E-09	CC 2	6.17E-09	CC 2	Cm 242		8		8
Cs 135		8		8	Cm 243		8		8
Cs 137	3.07E-05	CC 2	3.07E-05	CC 2	Cm 244	1.07E-08	CC 2	1.07E-08	CC 2
Ba 133	2.63E-08	CC 2	2.63E-08	CC 2	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	5.2E-08	CC 2	5.2E-08	CC 2	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151		8		8	Other a				
Eu 152	7.31E-08	CC 2	7.31E-08	CC 2	Other b/g				
Eu 154	1.86E-07	CC 2	1.86E-07	CC 2	<b>Total a</b>	<b>2.08E-05</b>	<b>CC 2</b>	<b>2.08E-05</b>	<b>CC 2</b>
Eu 155	3.39E-08	CC 2	3.39E-08	CC 2	<b>Total b/g</b>	<b>8.99E-05</b>	<b>CC 2</b>	<b>8.99E-05</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