

<b>WASTE STREAM</b>	<b>9A319</b>	<b>Secondary Wastes LLW</b>
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**SITE** Berkeley  
**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 <sup>3</sup>
Future arisings -	1.4.2074 - 31.3.2077.....	1116.0 m <sup>3</sup>
Total future arisings:		1116.0 m <sup>3</sup>
Total waste volume:		1116.0 m <sup>3</sup>

Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 3 years. Final Dismantling & Site Clearance is assumed to commence in 2070 with reactor dismantling commencing in 2074 and lasting for 3 years. The volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2074.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.2  
 Stock (lower): x Arisings (lower) x 0.8

**WASTE SOURCE** Wastes arising from contamination control procedures during plant dismantling.

**PHYSICAL CHARACTERISTICS**

General description: A variety of combustible and non combustible materials. No large items are expected.  
 Physical components (%vol): Metallic pipe and other items (~50% vol), plastic pipework, sheet and other items (~10% vol), rubber gloves and other items (~5% vol), clothing (~5% vol), wood (~5% vol), encapsulated sludge (~5% vol), air filters (~5% vol), combustible material (e.g. paper sheet) (~15-20 % vol). Percentages of constituents are very uncertain.  
 Sealed sources: The waste does not contain sealed sources.  
 Bulk density (t/m<sup>3</sup>): ~1  
 Comment on density: The density is likely to lie between 0.5 and 1.5 t/m<sup>3</sup>.

**CHEMICAL COMPOSITION**

General description and components (%wt): The waste is expected to include cloth (~5%vol), plastics (~15%vol), paper (~15%vol), wood (~5%vol), rubber (~5%vol), encapsulated sludge (~5%vol), metals (~50%vol). Percentages of constituents are very uncertain.  
 Chemical state: Neutral  
 Chemical form of radionuclides: H-3: The chemical form of tritium has not been assessed.  
 C-14: The chemical form of carbon 14 has not been assessed.  
 Cl-36: The chemical form of chlorine 36 has not been assessed.  
 Metals and alloys (%wt): Metal thicknesses will probably be typically 1-3 mm.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	<<1.0		
Other ferrous metals.....	~50.0		
Iron.....			
Aluminium.....	<<1.0		
Beryllium.....	0		
Cobalt.....			
Copper.....	<<1.0		
Lead.....	0		
Magnox/Magnesium.....	0		

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Nickel.....  
Titanium.....  
Uranium.....  
Zinc..... 0  
Zircaloy/Zirconium..... 0  
Other metals..... <<1.0     There may be "other" metals present (<<1%).

Organics (%wt):                      A wide variety of materials may be present. Halogenated plastics and rubbers are expected but the materials have not been determined.

	(%wt)	Type(s) and comment		% of total C14 activity
Total cellulosics.....	~25.0			
Paper, cotton.....	~20.0			
Wood.....	~5.0			
Halogenated plastics .....	<7.5			
Total non-halogenated plastics.....	<7.5			
Condensation polymers.....	<3.8			
Others.....	<3.8			
Organic ion exchange materials....	0			
Total rubber.....	~5.0			
Halogenated rubber .....	<2.5			
Non-halogenated rubber.....	<2.5			
Hydrocarbons.....				
Oil or grease .....				
Fuel.....				
Asphalt/Tarmac (cont.coal tar)...				
Asphalt/Tarmac (no coal tar)....				
Bitumen.....				
Others.....				
Other organics.....	TR			

Other materials (%wt):                      Graphite may be present in at least trace quantities.

	(%wt)	Type(s) and comment		% of total C14 activity
Inorganic ion exchange materials..	0			
Inorganic sludges and flocs.....	0			
Soil.....	TR			
Brick/Stone/Rubble.....	TR			
Cementitious material.....	~5.0	encapsulated sludges		
Sand.....				
Glass/Ceramics.....	0			
Graphite.....	TR			
Desiccants/Catalysts.....				
Asbestos.....	0			
Non/low friable.....				

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Moderately friable.....  
 Highly friable.....  
 Free aqueous liquids..... 0  
 Free non-aqueous liquids..... 0  
 Powder/Ash..... 0

Inorganic anions (%wt): Only likely to be present in trace quantities.

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

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.....		
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.....		

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		

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- 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):      Yes

(%wt)      Type(s) and comment

- EDTA.....
- DPTA.....
- NTA.....
- Polycarboxylic acids.....
- Other organic complexants.....
- Total complexing agents.....      TR

Potential for the waste to contain discrete items:      Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs. NB If recycled then DI Limits n/a

**TREATMENT, PACKAGING AND DISPOSAL**

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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		100.0

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 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	100.0	1.0

Classification codes for waste expected to be consigned to a landfill facility: 17 04 05, 17 02 01, 17 02 03, 20 01 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
-	-	-	-	-	-

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

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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			

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: Contamination by activation products from the reactor structure.

Uncertainty: The activities quoted are those at the time of Final Dismantling & Site Clearance (85 years after Station shutdown).

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 activity has been calculated from the weighted average of all the other ILW and LLW streams assuming a total specific activity for the beta/gamma component.

Other information: The activities quoted are those at 85 years after reactor shutdown, i.e. in 2074.

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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			1.79E-06	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			2.28E-05	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26			1E-09	CC 2	Tm 171				8
Cl 36			6.39E-08	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			7.62E-08	CC 2	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55				8	Pb 210				8
Co 60			9.09E-08	CC 2	Bi 208				8
Ni 59			1.14E-06	CC 2	Bi 210m				8
Ni 63			7.4E-05	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				8	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92				6	Th 230				8
Nb 93m				8	Th 232				8
Nb 94			4.47E-08	CC 2	Th 234				8
Mo 93			5.49E-09	CC 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			1.17E-09	CC 2	U 232				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				8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m			4.51E-08	CC 2	Pu 238				8
Sn 123				8	Pu 239				8
Sn 126				8	Pu 240				8
Sb 125				8	Pu 241				8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241				8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				6	Cm 243				8
Cs 137				8	Cm 244				8
Ba 133				8	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				8	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				
Eu 152			1.22E-08	CC 2	Other b/g				
Eu 154				8	<b>Total a</b>	<b>0</b>		<b>0</b>	
Eu 155				8	<b>Total b/g</b>	<b>0</b>		<b>1.00E-04</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