

<b>WASTE STREAM</b>	<b>9C17</b>	<b>Magnox Dissolution Plant Sludge</b>
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**SITE** Dungeness 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.....	29.0 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>
Total waste volume:		29.0 m <sup>3</sup>

Comment on volumes: -

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

**WASTE SOURCE** The sludge originates from routine filtration of dissolution plant effluents.

**PHYSICAL CHARACTERISTICS**

General description: Insoluble constituents of Magnox. There are no large items that may require special handling.

Physical components (%wt): Sludge (100%). No other constituents anticipated.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): 1.1

Comment on density: The bulk density of the waste ranges from 1.05 to 1.15 t/m<sup>3</sup>. The average is 1.1 t/m<sup>3</sup>.

**CHEMICAL COMPOSITION**

General description and components (%wt): Insoluble residues from chemical dissolution of Magnox (including Fe, Co, Zn, Zr and Al). Siliceous materials including sand, some oil contamination and a range of other materials.

Chemical state: Alkali

Chemical form of radionuclides: H-3: Most tritium is expected to be present as water but some may be present in the form of other inorganic compounds or as organic compounds.  
 C-14: Carbon 14 may be present as graphite.  
 Cl-36: The chemical form of chlorine 36 may be inorganic chloride.  
 U: The chemical form of uranium isotopes has not been determined but will probably be uranium oxides.  
 Pu: The chemical form of plutonium isotopes has not been determined but will probably be plutonium oxides.

Metals and alloys (%wt): No bulk or sheet metal items.

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

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Titanium.....

Uranium.....

Zinc..... NE

Zircaloy/Zirconium..... NE

Other metals..... NE      The "other" metal content has not been fully assessed.

Organics (%wt):      The cellulosic material content of the waste has not been assessed. Ion exchange materials would be expected in only trace amounts. There are no halogenated plastics or rubbers present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	NE		
Paper, cotton.....	NE		
Wood.....	NE		
Halogenated plastics .....	0		
Total non-halogenated plastics.....	0		
Condensation polymers.....	0		
Others.....	0		
Organic ion exchange materials....	TR		
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.....	~1.0		

Other materials (%wt):      -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	NE		
Inorganic sludges and flocs.....	~98.0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	NE		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			

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

Inorganic anions (%wt):            Not fully assessed. Carbonates are expected to be present.

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

Materials of interest for waste acceptance criteria:            There might be trace quantities of biological material. The possible presence of items that are not estimated is to be determined.

	(%wt)	Type(s) and comment
Combustible metals.....	<1.0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	TR	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....		
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	NE	
Reacting with water.....	<1.0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / non hazardous pollutants:            -

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

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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):    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:    No. In & of itself not a DI; assumed not likely to contain any "rogue" items that could be.

**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	On-site	100.0

Comment on planned treatments:

Solidification to meet LLWR WAC in HHISO's

**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	2.4

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
Disposal at LLWR	Disposal at a Geological Disposal Facility	NE	2023	Medium	Baseline position is encapsulation and LLW disposal but this is under threat, under investigation still

**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	100.0	4.15	7

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: -

**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: Contaminated sludge. Contamination by fission products, actinides and activation products.

Uncertainty: Activity is derived from sample results ref EX09246\_06\_10\_37

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: Three samples were taken and activity averaged ref EX09246\_06\_10\_37 and decayed by six years for RWI 2022

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	1.64E-03	BB 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	4.10E-04	BB 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	2.32E-07	BB 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		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	3.30E-05	BB 2			Pb 210		8		
Co 60	2.30E-04	BB 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63	3.94E-03	BB 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	5.58E-04	BB 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	4.07E-07	BB 2			Th 234	6.76E-05	BB 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	2.24E-06	BB 2			U 232		8		
Ru 106	6.36E-08	BB 2			U 233		8		
Pd 107		8			U 234	1.43E-06	BB 2		
Ag 108m	2.32E-05	BB 2			U 235	5.50E-07	BB 2		
Ag 110m		8			U 236	5.50E-07	BB 2		
Cd 109		8			U 238	6.76E-05	BB 2		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	6.45E-05	BB 2		
Sn 123		8			Pu 239	1.74E-04	BB 2		
Sn 126		8			Pu 240	1.74E-04	BB 2		
Sb 125	2.70E-07	BB 2			Pu 241	1.18E-03	BB 2		
Sb 126		8			Pu 242		8		
Te 125m	6.77E-08	BB 2			Am 241	3.09E-04	BB 2		
Te 127m		8			Am 242m		8		
I 129	1.84E-08	BB 2			Am 243		8		
Cs 134	8.78E-08	BB 2			Cm 242		8		
Cs 135		8			Cm 243	7.11E-07	BB 2		
Cs 137	1.57E-04	BB 2			Cm 244	6.49E-07	BB 2		
Ba 133	4.97E-06	BB 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		8			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		8			Other a				
Eu 152	7.79E-07	BB 2			Other b/g				
Eu 154	6.90E-06	BB 2			<b>Total a</b>	<b>7.93E-04</b>	<b>BB 2</b>	<b>0</b>	
Eu 155	7.16E-07	BB 2			<b>Total b/g</b>	<b>8.25E-03</b>	<b>BB 2</b>	<b>0</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