

<b>WASTE STREAM</b>	<b>9F17</b>	<b>Sludge</b>
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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.....	12.8 m <sup>3</sup>
Total future arisings:	0 m <sup>3</sup>
Total waste volume:	12.8 m <sup>3</sup>

Comment on volumes: These volumes do not include pond sludge.

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 liquid effluents and cooling pond water treatment and from clean-up operations of the cooling ponds and Effluent Treatment Plant / associated storage tanks. There is also a limited amount of paper filters from the final active filter.

**PHYSICAL CHARACTERISTICS**

General description: The waste consists of debris washed from persons, corrosion products such as magnesium hydroxide and carbonate detached from fuel elements and extraneous materials such as flakes of paint. Also there is some filter sand. Sludge particles may be up to millimetre size, and there will probably be 50-450 kg/m<sup>3</sup> of solid material. Once fluidised the sludges should be readily transferred by pumping but reconcentration may be time consuming. There is also paper present in the form of filter circles from the final active filter. There are no large items that may require special handling. However, consideration must be given to how the filter paper will be removed.

Physical components (%vol): Sludge (>97%) and paper (<3%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): 1.4

Comment on density: -

**CHEMICAL COMPOSITION**

General description and components (%wt): Magnesium hydroxide, magnesium carbonate, water, sand and a wide variety of other materials. There are small quantities of steel, PVC and paper.

Chemical state: Alkali

Chemical form of radionuclides: H-3: Chemical form of tritium has not been assessed but may be present as water or as other inorganic compounds or as organic compounds.  
C-14: The chemical form of carbon 14 has not been determined.  
Cl-36: The chemical form of chlorine 36 has not been determined.  
Se-79: The chemical form of selenium has not been determined.  
Tc-99: The chemical form of technetium has not been determined.  
Ra: The chemical form of radium isotopes has not been determined.  
Th: The thorium isotope content is insignificant.  
U: The chemical form of uranium isotopes has not been determined.  
Np: The chemical form of neptunium has not been determined.  
Pu: The chemical form of plutonium isotopes has not been determined.

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

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	<0.50		
Iron.....			
Aluminium.....	NE		
Beryllium.....	NE		
Cobalt.....			
Copper.....	NE		
Lead.....	NE		
Magnox/Magnesium.....	<10.0	Some unreacted Magnox may be present.	
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	NE		
Zircaloy/Zirconium.....	NE		
Other metals.....	NE	The presence of "other" metals has not been fully assessed.	

Organics (%wt):

There may be some oil and grease. Organic ion exchange resins would be expected in only trace quantities, if any. Some cellulose in the form of paper is present. Small quantities of PVC are present (<0.1% wt).

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	<3.0		
Paper, cotton.....	<3.0		
Wood.....	0		
Halogenated plastics .....	<0.10	PVC	
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.....	NE		

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.....	~97.0		
Soil.....	0		
Brick/Stone/Rubble.....	TR		
Cementitious material.....	TR		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	TR		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	P		
Free non-aqueous liquids.....	NE		
Powder/Ash.....	0		

Inorganic anions (%wt):           Not fully assessed. Carbonates and sulphates may 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:           The waste is unlikely to present a fire hazard but this requires confirmation since Magnox may be present and can ignite under appropriate conditions. 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.....	<10.0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	TR	
Biodegradable materials.....	0	
Putrescible wastes.....	0	

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Non-putrescible wastes.....  
 Corrosive materials..... 0  
 Pyrophoric materials..... 0  
 Generating toxic gases..... NE  
 Reacting with water..... <10.0  
 Higher activity particles.....  
 Soluble solids as bulk chemical  
 compounds.....

Hazardous substances / -  
 non hazardous pollutants:

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

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

**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	On-site	100.0

Comment on planned treatments:

Waste will be mixed in a cementitious matrix and solidified in nominal 210-litre drums, for disposal in a half-height ISO container.

**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:**      -

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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 <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	~2.4	6

Other information: -

**Waste Planned for Disposal at the LLW Repository:**

Container voidage: No significant inaccessible voidage is expected.

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: No. waste will be retrieved from tanks for processing and disposal when AETP decommissioned

**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: Specific activity is a function of Station operating history.

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 values quoted were derived by extrapolation from available measurements and are indicative of the activities that might be expected.

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	2.16E-05	CC 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	7.38E-06	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36		8			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	6.69E-06	CC 2			Pb 210		8		
Co 60	1.22E-05	CC 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63		8			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	1.60E-04	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		8			Th 234		8		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99		8			U 232		8		
Ru 106	5.19E-07	CC 2			U 233		8		
Pd 107		8			U 234	1.99E-09	CC 2		
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		8			Pu 238	7.72E-05	CC 2		
Sn 123		8			Pu 239	4.31E-05	CC 2		
Sn 126		8			Pu 240	4.31E-05	CC 2		
Sb 125	1.2E-06	CC 2			Pu 241	1.76E-03	CC 2		
Sb 126		8			Pu 242		8		
Te 125m	3.01E-07	CC 2			Am 241	1.12E-04	CC 2		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	6.36E-06	CC 2			Cm 242		8		
Cs 135		8			Cm 243		8		
Cs 137	4.58E-03	CC 2			Cm 244		8		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	2.89E-08	CC 2			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	4.34E-07	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	6.02E-05	CC 2			Other a				
Eu 152		8			Other b/g		CC 2		
Eu 154	1.42E-05	CC 2			<b>Total a</b>	<b>2.75E-04</b>	<b>CC 2</b>	<b>0</b>	
Eu 155	4.75E-06	CC 2			<b>Total b/g</b>	<b>6.64E-03</b>	<b>CC 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