

WASTE STREAM	9D23	Sludge
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SITE Hinkley Point A
SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	~4.8 m ³
Total future arisings:		0 m ³
Total waste volume:		4.8 m ³
Comment on volumes:	Volumes may be between 5 and 15m ³ and are still to be confirmed	
Uncertainty factors on volumes:	Stock (upper): x 1.3	Arisings (upper) x
	Stock (lower): x 0.5	Arisings (lower) x

WASTE SOURCE The sludge originates from routine filtration of liquid effluents and cooling pond water and from special clean-up operations on cooling ponds.

PHYSICAL CHARACTERISTICS

General description: The waste consists of fuel pond corrosion products such as magnesium hydroxide and carbonate detached from fuel elements and extraneous materials such as flakes of paint and ion exchange from Caesium Removal units. Also there is some filter sand. Sludge particles may be up to millimetre size, and there will probably be 80-900 kg/m³ of solid material. Once fluidised the sludges should be readily transferred by pumping but reconcentration may be time consuming. There are no large items that may require special handling.

Physical components (%wt): Sand and sludge (52%), water (48%). No other constituents anticipated.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 1.2

Comment on density: The bulk density of the waste ranges from 0.8 to 1.5 t/m³, with an average of about 1.2 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Water (48% wt), sand/sludge (52% wt). The chemical components of these items are magnesium hydroxide, magnesium carbonate, silica and a range of other materials including ferric oxide and magnetite.

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 chlorine 36 content is insignificant.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
Ra: The radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: The chemical form of uranium isotopes has not been determined but will probably be uranium oxides.
Np: The chemical form of neptunium has not been determined.
Pu: The chemical form of plutonium isotopes has not been determined but will probably be plutonium oxides.

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

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	P		
Iron.....			
Aluminium.....	P		
Beryllium.....	0		
Cobalt.....			
Copper.....	0		
Lead.....	P		
Magnox/Magnesium.....	P	Some unreacted Magnox is expected.	
Nickel.....			
Titanium.....	P		
Uranium.....	P		
Zinc.....	P		
Zircaloy/Zirconium.....	P		
Other metals.....	0	There are no "other" metals.	

Organics (%wt): There may be trace quantities of organic material present in the waste. There are no halogenated plastics or rubbers present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	0		
Paper, cotton.....	0		
Wood.....	0		
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.....	TR		

Other materials (%wt): -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	TR		
Inorganic sludges and flocs.....	~30.0	Including Ferrous metals (3.7%), aluminium (0.3%), lead (0.02%), magnesium (14%), titanium (0.03%), uranium (1.2%), zinc (0.06%) and zirconium/zircaloy (0.02%)	
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....	~22.0		
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	48.0		
Free non-aqueous liquids.....	TR		
Powder/Ash.....	0		

Inorganic anions (%wt): Carbonates, sulphates and traces of sodium silicate and alumino-silicates are expected.

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	0	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	6.3	
Nitrate.....	0	
Nitrite.....	0	
Phosphate.....	0	
Sulphate.....	2.0	
Sulphide.....	0	

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 will ignite under appropriate conditions. There might be trace quantities of biological material.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	TR	

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

Hazardous substances / None expected
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.....		

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EEE Type 5.....

Complexing agents (%wt): No

(%wt) Type(s) and comment

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Total complexing agents..... 0

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.

PACKAGING AND CONDITIONING

Conditioning method: encapsulation of mobile waste into 3m3 box

Plant Name: -

Location: Hinkley Point A Site

Plant startup date: 2022

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: 2022

Throughput for this stream (m³/y incoming waste): -

Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	3m ³ box (round corners)	100.0	1.5	2.9	4

Likely container type comment: -

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: -

Other information: -

Conditioned density (t/m³): -

Conditioned density comment: -

Other information on conditioning: -

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
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RADIOACTIVITY

Source:	Contaminated sludge. Contamination by fission products, actinides and activation products.
Uncertainty:	Specific activity is a function of Station operating history. The values quoted are indicative of the activities that might be expected. Uncertainty bands remain unchanged from extant RWI as it was not deemed possible to provide robust justification for decreasing uncertainty based on the limited sampling carried out as part of the characterisation review.
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 listed represent decay corrections (to reference date of 01/04/2022) of results listed in Table 2 (reference date 01/10/2017) of the characterisation review (PROG/HPA/SCB/0355) aside from results for U-235, U-236, Pu-239, Pu-240, Cm-243 and Cm-244. These are derived based on cited values for their nuclide pairs. The rationale for the relative proportions of U, Pu, Cm pairs used here to infer individual values (20% U-235/80%U-236, 50% Pu-239/50%Pu-240 and 1.45% Cm-243/98.55% Cm-244) are described in section 5.5 of the characterisation report. Value for Th-234 is inferred from that for U-238 assuming these two nuclides are in secular equilibrium.
Other information:	-

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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	5.80E-03	CC 2		8	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	4.67E-03	CC 2		8	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36		8		8	Lu 174		8		8
Ar 39		8		8	Lu 176		8		8
Ar 42		8		8	Hf 178n		8		8
K 40	<9.21E-05	C 3		8	Hf 182		8		8
Ca 41		8		8	Pt 193		8		8
Mn 53		8		8	Tl 204		8		8
Mn 54	<9.19E-07	C 3		8	Pb 205		8		8
Fe 55	7.28E-04	CC 2		8	Pb 210		8		8
Co 60	3.74E-03	CC 2		8	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	1.23E-02	CC 2		8	Po 210		8		8
Zn 65	<7.38E-07	C 3		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	1.11E+00	CC 2		8	Th 227		8		8
Zr 93		8		8	Th 228	7.63E-06	8		8
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230	3.85E-09	8		8
Nb 93m		8		8	Th 232		8		8
Nb 94		8		8	Th 234	<1.77E-04	C 3		8
Mo 93		8		8	Pa 231		8		8
Tc 97		8		8	Pa 233	<6.46E-07	C 3		8
Tc 99	1.41E-03	CC 2		8	U 232	<1.14E-05	C 3		8
Ru 106	<1.31E-05	C 3		8	U 233		8		8
Pd 107		8		8	U 234	1.4E-04	CC 2		8
Ag 108m		8		8	U 235	4.47E-06	CC 2		8
Ag 110m		8		8	U 236	1.79E-05	CC 2		8
Cd 109		8		8	U 238	1.77E-04	CC 2		8
Cd 113m		8		8	Np 237	6.66E-07	CC 2		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	8.87E-02	CC 2		8
Sn 123		8		8	Pu 239	1.23E-01	CC 2		8
Sn 126		8		8	Pu 240	1.23E-01	CC 2		8
Sb 125	<7.03E-05	C 3		8	Pu 241	1.62E+00	CC 2		8
Sb 126		8		8	Pu 242		8		8
Te 125m	1.76E-05	8		8	Am 241	5.76E-01	CC 2		8
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134	<8.61E-06	C 3		8	Cm 242	<1.71E-06	C 3		8
Cs 135		8		8	Cm 243	8.14E-05	CC 2		8
Cs 137	1.07E-01	CC 2		8	Cm 244	5.18E-03	CC 2		8
Ba 133		8		8	Cm 245		8		8
La 137		8		8	Cm 246		8		8
La 138		8		8	Cm 248		8		8
Ce 144	<6.27E-06	C 3		8	Cf 249		8		8
Pm 145		8		8	Cf 250		8		8
Pm 147	3.99E-04	CC 2		8	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151	3.92E-02	CC 2		8	Other a				
Eu 152		8		8	Other b/g				
Eu 154	6.50E-03	CC 2		8	Total a	9.16E-01	CC 2	0	
Eu 155	9.10E-04	CC 2		8	Total b/g	2.92E+00	CC 2	0	

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