

WASTE STREAM	9E01	Sludge
---------------------	-------------	---------------

SITE Oldbury
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.....	14.7 m ³
Future arisings -	1.4.2023 - 31.3.2024.....	9.6 m ³
Total future arisings:		9.6 m ³
Total waste volume:		24.3 m ³

Comment on volumes: The predicted arisings may be an over estimate.

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

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 debris washed from persons, floors and clothing, 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/m³ of dry material. Once fluidised the sludges should be readily transferred by pumping but reconcentration may be time consuming. The density of sand from the emptying of process vessels is expected to be about 2 t/m³ with a voidage of about 0.15. There are no large items that may require special handling.

Physical components (%wt): Sludge and filter sand (100%). No other constituent anticipated.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 1.5

Comment on density: The mean density of the sludge is assumed to be 1.1 t/m³. However the density of sand from the emptying of process vessels will be about 2 t/m³ and so the overall average will be about 1.5 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Magnesium hydroxide, magnesium carbonate, water and a wide variety of other materials which may include graphite dust from surfaces of fuel cans.

Chemical state: Alkali

Chemical form of radionuclides: H-3: Tritium will be present in trace amounts as tritiated water.
C-14: Carbon 14 will be present as graphite dust particles.
Cl-36: Chlorine 36 may be present in graphite dust particles.
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: Uranium isotopes are expected to be present from trace contamination of the Magnox can surrounding fuel elements and as natural uranium metal.
Np: The neptunium content is insignificant.
Pu: Plutonium isotopes are expected to be present as trace amounts from minor fuel leakage, probably metallic.

Metals and alloys (%wt): There are no bulk or sheet metallic items present.

WASTE STREAM	9E01	Sludge
---------------------	-------------	---------------

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	TR		
Other ferrous metals.....	TR		
Iron.....			
Aluminium.....	0.07		
Beryllium.....	0		
Cobalt.....			
Copper.....	<0.01		
Lead.....	<0.01		
Magnox/Magnesium.....	TR		
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	<0.01		
Zircaloy/Zirconium.....	TR		
Other metals.....	0		

Organics (%wt): There may be some oil and grease (<0.04% wt). Halogenated plastics and rubbers will not be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics	0		
Total non-halogenated plastics.....	0		
Condensation polymers.....	0		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0		
Halogenated rubber	0		
Non-halogenated rubber.....	0		
Hydrocarbons.....			
Oil or grease	<0.04		
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....			

Other materials (%wt): Traces of graphite may be present.

WASTE STREAM	9E01	Sludge
---------------------	-------------	---------------

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	~50.0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....			
Sand.....	NE		
Glass/Ceramics.....	0		
Graphite.....	TR		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	>50.0		
Free non-aqueous liquids.....	TR		
Powder/Ash.....	0		

Inorganic anions (%wt): Not fully assessed.

	(%wt)	Type(s) and comment
Fluoride.....	TR	
Chloride.....	<0.01	
Iodide.....	TR	
Cyanide.....	0	
Carbonate.....	1.3	
Nitrate.....	TR	
Nitrite.....	TR	
Phosphate.....	TR	
Sulphate.....	<0.03	
Sulphide.....	TR	

Materials of interest for waste acceptance criteria: The waste is unlikely to present a fire hazard. 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.....	TR	
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.....		

WASTE STREAM	9E01	Sludge
---------------------	-------------	---------------

Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	NE
Reacting with water.....	TR
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.....		
EEE Type 5.....		

WASTE STREAM	9E01	Sludge
---------------------	-------------	---------------

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.

PACKAGING AND CONDITIONING

Conditioning method: To be dried in Type VI DCICs.

Plant Name: -

Location: Oldbury Power Station

Plant startup date: -

Total capacity (m³/y incoming waste): ~100.0

Target start date for packaging this stream: 2023

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

Other information: waste will be loaded using a fill/dry cycle to maximise loading volume

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
	3m³ RS box	100.0	6.75	2.5	4

Likely container type comment: Waste will be transferred to Type VI yellow boxes and dried.

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: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at a Geological Disposal	Disposal at LLWR	99.0	2023	Medium	Potential for disposal as LLW following encapsulation to meet LLWR WAC.

WASTE STREAM

9E01

Sludge

Facility

Similar to recent experience at DNA with wet boundary wastes.

RADIOACTIVITY

Source:	Contaminated sludge. Pond sludge incorporating fission products, activation products and actinides.
Uncertainty:	Specific activity is a function of Station operating history and pond conditions. The values quoted are indicative of the activities that might 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 activities quoted were derived from available measurements.
Other information:	-

WASTE STREAM 9E01 Sludge

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	1.24E-03	CC 2	1.17E-03	CC 2	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	6.99E-03	CC 2	6.99E-03	CC 2	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26	3E-05	CC 2	3E-05	CC 2	Tm 171		8		8
Cl 36	3E-07	CC 2	3E-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	1.90E-04	CC 2	1.48E-04	CC 2	Pb 210		8		8
Co 60	1.50E-04	CC 2	1.31E-04	CC 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	9.22E-05	CC 2	9.16E-05	CC 2	Po 210		8		8
Zn 65	<1.08E-08	C 3	<3.83E-09	C 3	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	1.52E-03	CC 2	1.48E-03	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		8		8	Th 234	1E-07	CC 2	1E-07	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	1.03E-07	CC 2	1.03E-07	CC 2
Ag 108m	<5.97E-06	C 3	<5.96E-06	C 3	U 235		8		8
Ag 110m		8		8	U 236	1E-08	CC 2	1E-08	CC 2
Cd 109		8		8	U 238	1E-07	CC 8	1E-07	CC 8
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	5.56E-05	CC 2	5.51E-05	CC 2
Sn 123		8		8	Pu 239	4E-05	CC 2	4E-05	CC 2
Sn 126		8		8	Pu 240	7E-05	CC 2	7E-05	CC 2
Sb 125		8		8	Pu 241	1.99E-03	CC 2	1.89E-03	CC 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	3.31E-04	CC 2	3.34E-04	CC 2
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134	2.14E-04	CC 2	1.53E-04	CC 2	Cm 242		8		8
Cs 135		8		8	Cm 243	4.07E-09	CC 2	3.98E-09	CC 2
Cs 137	2.46E-02	CC 2	2.40E-02	CC 2	Cm 244	1.15E-06	CC 2	1.11E-06	CC 2
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		8		8	Cf 249		8		8
Pm 145		8		8	Cf 250		8		8
Pm 147	9.73E-06	CC 2	7.47E-06	CC 2	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151	2.74E-05	CC 2	2.72E-05	CC 2	Other a				
Eu 152		8		8	Other b/g	1.56E-09	CC 2		
Eu 154	1.56E-05	CC 2	1.44E-05	CC 2	Total a	4.98E-04	CC 2	5E-04	CC 2
Eu 155		8		8	Total b/g	3.70E-02	CC 2	3.62E-02	CC 2

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