

WASTE STREAM	9H33	Graphite ILW
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SITE Wylfa
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.....	<< 0.1 m ³
Total future arisings:		0 m ³
Total waste volume:		<< 0.1 m ³
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper): x 1.1	Arisings (upper) x
	Stock (lower): x 0.9	Arisings (lower) x

WASTE SOURCE 3 installed graphite samples that were originally intended to be placed back into the reactor. Due to damage this is now not possible.

PHYSICAL CHARACTERISTICS

General description: Three graphite samples stored in three flasks. Flasks are not included in waste stream composition/volume.
 Physical components (%wt): Graphite samples (100%)
 Sealed sources: The waste does not contain sealed sources.
 Bulk density (t/m³): ~1.6
 Comment on density: -

CHEMICAL COMPOSITION

General description and components (%wt): Graphite 4.55kg per flask (100%).
 Chemical state: Neutral
 Chemical form of radionuclides: H-3: Tritium may be chemically bound with the graphite.
 C-14: Carbon 14 will be present as graphite.
 Cl-36: Chlorine 36 will probably be chemically bound to the graphite. Some may be linked chemically with impurities in the graphite.
 Se-79: The selenium content is insignificant.
 Tc-99: The technetium content is insignificant.
 Ra: Radium isotope content is insignificant.
 Th: The thorium content is insignificant.
 U: There may be traces of uranium as metal or oxide.
 Np: The neptunium content is insignificant.
 Pu: There may be traces of plutonium as metal or oxide.
 Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	TR		
Other ferrous metals.....	0		
Iron.....			
Aluminium.....	0		
Beryllium.....	TR		
Cobalt.....			
Copper.....	0		
Lead.....	0		

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Magnox/Magnesium.....	0	
Nickel.....		
Titanium.....		
Uranium.....	TR	
Zinc.....	0	
Zircaloy/Zirconium.....	0	
Other metals.....	0	There are no "other" metals present.

Organics (%wt): None expected. Halogenated plastics and rubbers will not be 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....	0		
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.....	0		

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	100.0		100.0
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): None of the inorganic anions listed in the table is expected to be present at greater than trace concentration.

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

Materials of interest for waste acceptance criteria: No materials likely to pose a fire or other non-radiological hazard have been identified. Graphite presents a low fire risk; it is difficult but not impossible to ignite.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	TR	Detected at trace levels in inactive graphite material.
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
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: none expected

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

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Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....	TR	Detected at trace levels in inactive graphite material.
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....		
Caesium.....		
Selenium.....		
Chromium.....		
Molybdenum.....		
Thallium.....	TR	Detected at trace levels in inactive graphite material.
Tin.....		
Vanadium.....		
Mercury compounds.....		
Others.....	TR	Gallium, germanium and rubidium detected at trace levels in inactive graphite material.
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		
EEE Type 2.....		
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		

Complexing agents (%wt):

	(%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: Yes. Graphite Bricks/Tiles assumed to be DIs

PACKAGING AND CONDITIONING

Conditioning method: The graphite samples are expected to be removed from the flasks and co-packaged with another stream (likely 9H34). There is a chance the samples may not be able to be removed due to degradation. Future optioneering will determine whether this is the case and the flasks may need to be disposed of as well (but not currently included in waste stream composition). A BAT is required to determine the best disposal option for this stream.

Plant Name: -

Location: -

Plant startup date: -

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: -

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

Other information: Waste is likely to be co-packaged with 9H34.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages

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: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

RADIOACTIVITY

Source: Activation of the graphite and impurities.

Uncertainty: The values quoted were derived by calculation from available material specification and are indicative of the activities that are expected. The major source of uncertainty is the impurity levels.

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'.

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Measurement of
radioactivities:

The specific activities were estimated from neutron activation calculations of the material
and its impurities.

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	2.21E-01	CC 2			Gd 153				
Be 10		8			Ho 163				
C 14	1.70E-01	CC 2			Ho 166m	4.57E-06	CC 2		
Na 22		8			Tm 170				
Al 26		8			Tm 171				
Cl 36	3.61E-04	CC 2			Lu 174				
Ar 39		8			Lu 176				
Ar 42		8			Hf 178n				
K 40		8			Hf 182				
Ca 41	4.3E-04	CC 2			Pt 193				
Mn 53		8			Tl 204				
Mn 54		8			Pb 205				
Fe 55	1.13E-01	CC 2			Pb 210				
Co 60	2.66E-01	CC 2			Bi 208				
Ni 59	4.23E-05	CC 2			Bi 210m				
Ni 63	5.72E-03	CC 2			Po 210				
Zn 65		8			Ra 223				
Se 79		8			Ra 225				
Kr 81		8			Ra 226				
Kr 85		8			Ra 228				
Rb 87		8			Ac 227				
Sr 90		8			Th 227				
Zr 93		8			Th 228				
Nb 91		8			Th 229				
Nb 92		8			Th 230				
Nb 93m		8			Th 232				
Nb 94	5.10E-07	CC 2			Th 234				
Mo 93		8			Pa 231				
Tc 97		8			Pa 233				
Tc 99		8			U 232				
Ru 106		8			U 233				
Pd 107		8			U 234				
Ag 108m	6.32E-06	CC 2			U 235				
Ag 110m		8			U 236				
Cd 109		8			U 238				
Cd 113m		8			Np 237				
Sn 119m		8			Pu 236				
Sn 121m	8.25E-04	CC 2			Pu 238				
Sn 123		8			Pu 239				
Sn 126		8			Pu 240				
Sb 125		8			Pu 241				
Sb 126		8			Pu 242				
Te 125m		8			Am 241				
Te 127m		8			Am 242m				
I 129		8			Am 243				
Cs 134	2.84E-05	CC 2			Cm 242				
Cs 135		8			Cm 243				
Cs 137		8			Cm 244				
Ba 133	1.41E-04	CC 2			Cm 245				
La 137		8			Cm 246				
La 138		8			Cm 248				
Ce 144		8			Cf 249				
Pm 145	6.37E-06	CC 2			Cf 250				
Pm 147		8			Cf 251				
Sm 147		8			Cf 252				
Sm 151	1.67E-06	CC 2			Other a				
Eu 152	1.5E-04	CC 2			Other b/g				
Eu 154	2.40E-04	CC 2			Total a	0			0
Eu 155	1.44E-04	CC 2			Total b/g	7.79E-01	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