

**WASTE STREAM****2F07****AGR Graphite Fuel Assembly Components**

**SITE** Sellafield  
**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Sellafield Limited

**WASTE TYPE** ILW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	5688.1 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2023.....	158.6 m <sup>3</sup>
	1.4.2023 - 31.3.2024.....	222.5 m <sup>3</sup>
	1.4.2024 - 31.3.2025.....	266.7 m <sup>3</sup>
	1.4.2025 - 31.3.2026.....	234.3 m <sup>3</sup>
	1.4.2026 - 31.3.2027.....	205.2 m <sup>3</sup>
	1.4.2027 - 31.3.2028.....	146.0 m <sup>3</sup>
	1.4.2028 - 31.3.2029.....	63.1 m <sup>3</sup>
	1.4.2029 - 31.3.2030.....	51.3 m <sup>3</sup>
	1.4.2030 - 31.3.2031.....	96.3 m <sup>3</sup>
	1.4.2031 - 31.3.2032.....	113.6 m <sup>3</sup>
	1.4.2032 - 31.3.2033.....	111.3 m <sup>3</sup>
	1.4.2033 - 31.3.2034.....	38.7 m <sup>3</sup>
Total future arisings:		1707.6 m <sup>3</sup>
Total waste volume:		7395.7 m <sup>3</sup>
Comment on volumes:	Arisings dependent on dismantling programme based on anticipated future AGR receipt rates. Liner volume = 0.367m <sup>3</sup> . 10.5 elements per drum. Current volumes (m <sup>3</sup> ) equate to 15,499 ILW drums in AGR store and in EPS.	
Uncertainty factors on volumes:	Stock (upper):	x 1.01
	Stock (lower):	x 0.99
	Arisings (upper):	x 1.1
	Arisings (lower):	x 0.9

**WASTE SOURCE** From the dismantling of AGR fuel prior to storage.

**PHYSICAL CHARACTERISTICS**

General description: Activated AGR graphite debris. No items require special handling. The waste has not undergone any change since it was generated.

Physical components (%vol): Graphite (100%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): 0.7

Comment on density: -

**CHEMICAL COMPOSITION**

General description and components (%wt): Graphite (100%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Probably in gaseous form.  
 C-14: Activated graphite.  
 Cl-36: Not significant.  
 Se-79: Not present.  
 Tc-99: Not present.  
 I-129: Not present.  
 Ra: Not present.  
 Th: Not present.  
 U: Not present.  
 Np: Not present.  
 Pu: Not present.

Metals and alloys (%wt): Metal is not present.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	0		
Iron.....	0		
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....	0		
Titanium.....	0		
Uranium.....	0		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	0		
Organics (%wt):	No organic materials are 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.....	0		
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		

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.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	100.0		100.0
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	TR		

Inorganic anions (%wt):      None likely to be present.

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

Materials of interest for waste acceptance criteria:      No hazardous materials likely to be present.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	0	

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	0
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / No hazardous substances expected.  
non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	0	
Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	
Phenol.....	0	
Styrene.....	0	
Tri-butyl phosphate.....	0	
Other organophosphates.....	0	
Vinyl chloride.....	0	
Arsenic.....	0	
Barium.....	0	
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	0	
Caesium.....	0	
Selenium.....	0	
Chromium.....	0	
Molybdenum.....	0	
Thallium.....	0	
Tin.....	0	
Vanadium.....	0	
Mercury compounds.....	0	
Others.....	0	
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): No

(%wt) Type(s) and comment

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

No organic or inorganic complexing agents are present.

Total complexing agents..... 0

Potential for the waste to contain discrete items: Yes. Drummed graphite waste could be considered as Discrete Item.

**PACKAGING AND CONDITIONING**

Conditioning method: -

Plant Name: Not yet established.

Location: Sellafield.

Plant startup date: -

Total capacity (m<sup>3</sup>/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m<sup>3</sup>/y incoming waste): -

Other information: -

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
500 l drum	100.0	0.367	0.367	20152

Likely container type comment: -

Range in container waste volume: -

Other information on containers: Waste is in two types of drum - mild steel and stainless steel. Waste drums stored in AGR Store and EP Stores.

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m<sup>3</sup>): NE

Conditioned density comment: -

Other information on conditioning: Conditioning plans are not established.

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at a	Disposal at LLWR	6.0	2026	Medium	1,122 drums identified for potential

**WASTE STREAM****2F07****AGR Graphite Fuel Assembly Components**Geological Disposal  
Facility

recategorisation as LLW.

Disposal at a  
Geological Disposal  
Facility

Disposal at LLWR

25.0

2026

Medium

Potential for further 25% of drums to  
be recategorised.**RADIOACTIVITY**

Source:

The source is activation products within the graphite and possibly fission product contamination.

Uncertainty:

Best available.

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:

-

Other information:

There are no other alpha or other beta/gamma nuclides given.

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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	7.90E-02	CC 2	2.00E-01	CC 2	Gd 153				
Be 10					Ho 163				
C 14	6.98E-03	CC 2	7.00E-03	CC 2	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36	2.68E-05	BB 2	2.68E-05	BB 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	3.57E-06	CC 2	1.00E-04	CC 2	Pb 205				
Fe 55	2.16E-02	CC 2	2.00E-01	CC 2	Pb 210				
Co 60	3.85E-03	CC 2	2.00E-02	CC 2	Bi 208				
Ni 59	2.00E-05	CC 2	2.00E-05	CC 2	Bi 210m				
Ni 63	1.74E-03	CC 2	2.00E-03	CC 2	Po 210				
Zn 65	2.80E-06	CC 2	1.00E-04	CC 2	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	1.93E-10	CC 2	3.00E-10	CC 2	Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94	5.00E-11	CC 2	5.00E-11	CC 2	Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235				
Ag 110m					U 236				
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	8.39E-08	CC 2	1.00E-06	CC 2	Cm 242				
Cs 135	7.00E-13	CC 2	7.00E-13	CC 2	Cm 243				
Cs 137	4.56E-08	CC 2	7.00E-08	CC 2	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					<b>Total a</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>5</b>
Eu 155					<b>Total b/g</b>	<b>1.13E-01</b>	<b>CC 2</b>	<b>4.29E-01</b>	<b>CC 2</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