

WASTE STREAM	5C45/C	Encapsulated GLEEP Fuel
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SITE Harwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025		= 22.8	32.5
Future arisings:				0.0
				0.0
Total future arisings:			0.0	0.0
Total waste volume:			22.8	32.5

Number of waste packages in stock: At 1.4.2025..... 57 packages

Comment on arising rates: -

Additional information on quantities: There are a total of 339 cans - All GLEEP Fuel has been repacked into 57 drums of which all fifty seven have now been encapsulated and are included in this stream. Volume represents the inner drum volume.

Uncertainty factors on volumes:

Stock (upper):	x 1.10	Arisings (upper):	x -
Stock (lower):	x 0.90	Arisings (lower):	x -

WASTE SOURCE Fuel lightly irradiated in GLEEP reactor.

PHYSICAL CHARACTERISTICS

General description: Natural uranium rods in aluminium cans packed inside 23 litre storage cans. There are no large items in the waste.

Changes since waste generated: There have been no physical or chemical changes since the waste was generated.

Bulk density (t/m³): = 2.7

Comment on density: Density calculated using total conditioned wasteform mass and total conditioned volume.

CHEMICAL COMPOSITION

General description and components (%wt): GLEEP Fuel (50 wt%, containing uranium (49 wt%), aluminium (1 wt%) and trace graphite). Stainless steel cans (3 wt%), polymer (5 wt%), grout (41 wt%).

Chemical state: Neutral

Sheet metal proportion / thickness: Uranium fuel rods are about 300mm long and 25mm in diameter. Aluminium cladding is 0.6mm thick for 15% of rods and 1mm thick for 85% of rods.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 3.0	Stainless steel cans	
Other ferrous metals.....	= 0	-	
Iron.....		-	
Aluminium.....	= 1.0	-	
Beryllium.....		-	
Cobalt.....		-	
Copper.....	= 0	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....		-	
Titanium.....		-	
Uranium.....	= 49.0	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	= 0	-	

Organics (%wt):

	(%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.....		-	
Fuel.....		-	
Asphalt/Tarmac (cont.coal tar).....		-	
Asphalt/Tarmac (no coal tar).....		-	
Bitumen.....		-	
Others.....		-	
Other organics.....	= 5.0	Alchemix 4760 epoxy resin polymer	

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.....	= 41.0	-	
Sand.....		-	
Glass/Ceramics.....	= 0	-	
Graphite.....	TR	-	
Desiccants/Catalysts.....		-	
Asbestos.....	= 0	-	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
Free aqueous liquids.....	= 0	-	
Free non-aqueous liquids.....	= 0	-	
Powder/Ash.....	= 0	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%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:

	(%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.....		-
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:

	(%wt)	Type(s) and comment
Acrylamide.....	0	-
Benzene.....		-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....		-
Phenol.....		-
Styrene.....		-
Tri-butyl phosphate.....		-
Other organophosphates.....		-
Vinyl chloride.....		-
Arsenic.....		-
Barium.....		-
Boron.....		-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....		-
Caesium.....		-
Selenium.....		-
Chromium.....		-
Molybdenum.....		-
Thallium.....		-
Tin.....		-
Vanadium.....		-
Mercury compounds.....		-
Others.....		-

Complexing agents (%wt):

No		
	(%wt)	Type(s) and comment
EDTA.....	= 0	-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....		-
Other organic complexants.....		-
Total complexing agents.....		-

Physical components:

	Number	Type(s) and comment
Sources.....		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1.....		-
EEE Type 2.....		-
EEE Type 3.....		-
EEE Type 4.....		-
EEE Type 5.....		-

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off-site	Stream volume %
Size reduction		
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application		
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		

Comments on planned treatments:

Conditioning method: The GLEEP fuel wastes are pre-treated by adding polymer to each 23 litre can. The 23 litre cans are packaged in 500-litre drums, 6 cans per drum, and have been encapsulated using a cement grout. There were a total of 339 cans leading to 57 packages for encapsulation. One drum contains 3 cans.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

-

Further information on the conditioning matrix: -

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	500 l drum (pre-cast annular)	100.0	0.40	0.40	57	-

Range in container waste loading: Expect minimal variation.

Other information on packaging and conditioning: -

Conditioned density (t/m³): = 2.7
 Conditioned density comment: Density calculated using total conditioned wasteform mass and total conditioned volume.

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	100.0		
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: Short-lived daughter products are not included in total alpha and total beta/gamma specific activities.

Uncertainty: -

Measurement of radioactivities: -

Chemical form of radionuclides:

- H-3: -
- C-14: -
- Cl-36: -
- Se-79: -
- Tc-99: -
- I-129: -
- Ra: -
- Th: -
- U: Uranium metal.
- Np: -
- Pu: -

WASTE STREAM 5C45/C Encapsulated GLEEP Fuel									
Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	3.77E-05	C C 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14		8			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			Ti 204		8		
Mn 54		8			Pb 205		8		
Fe 55		8			Pb 210		8		
Co 60		8			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63		8			Po 210		8		
Zn 65		8			Ra 223	5.70E-07	C C 2		
Se 79	5.48E-07	C C 2			Ra 225		8		
Kr 81		8			Ra 226	9.49E-09	C C 2		
Kr 85	9.64E-04	C C 2			Ra 228		8		
Rb 87		8			Ac 227	5.72E-07	C C 2		
Sr 90	5.12E-02	C C 2			Th 227	5.63E-07	C C 2		
Zr 93	5.89E-06	C C 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	2.59E-06	C C 2		
Nb 93m	5.11E-06	C C 2			Th 232		8		
Nb 94		8			Th 234	1.65E-02	C C 2		
Mo 93		8			Pa 231	1.05E-06	C C 2		
Tc 97		8			Pa 233	1.20E-07	C C 2		
Tc 99	2.48E-05	C C 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	1.65E-02	C C 2		
Ag 108m		8			U 235	7.61E-04	C C 2		
Ag 110m		8			U 236	6.38E-07	C C 2		
Cd 109		8			U 238	1.65E-02	C C 2		
Cd 113m	1.01E-06	C C 2			Np 237	1.20E-07	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	1.21E-05	C C 2			Pu 238	9.49E-08	C C 2		
Sn 123		8			Pu 239	4.19E-03	C C 2		
Sn 126	5.35E-07	C C 2			Pu 240	1.61E-06	C C 2		
Sb 125	2.29E-07	C C 2			Pu 241	8.83E-08	C C 2		
Sb 126	7.49E-08	C C 2			Pu 242		8		
Te 125m	5.74E-08	C C 2			Am 241	5.23E-08	C C 2		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134		8			Cm 242		8		
Cs 135	1.89E-06	C C 2			Cm 243		8		
Cs 137	5.68E-02	C C 2			Cm 244		8		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	9.46E-06	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.99E-03	C C 2			Unsp a				
Eu 152	2.98E-07	C C 2			Unsp b/g				
Eu 154	4.75E-08	C C 2			Total a	3.80E-02	*	0	*
Eu 155	1.13E-05	C C 2			Total b/g	1.29E-01	*	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 the 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
* Total calculated from the 114 declared radionuclides