WASTE STREAM 5C45 GLEEP Fuel

SITE Harwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	1.9 m³
Total future arisings:		0 m³
Total waste volume:		1.9 m³

Comment on volumes: The total volume of the waste has been calculated using the dimensions of the fuel elements. The dimensions are well defined so the uncertainty on the volume of stocks is low. The bulk volume of the waste as stored in cans is 7.8m3. There are no future arisings for waste stream 5C45.There are a total of 339 cans - All GLEEP Fuel has been repacked into 57 drums.

Uncertainty factors on volumes:

Stock (upper):	x 1.1	Arisings (upper)	x
Stock (lower):	x 0.9	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. There have been no physical or chemical changes since the waste was generated.

Physical components (%vol): Natural Uranium metal fuel rods (100%).

Sealed sources: -

Bulk density (t/m³): 16

Comment on density: Density calculated from known masses and dimensions of elements.

CHEMICAL COMPOSITION

General description and components (%wt): 2.4 kg uranium metal rods coated with graphite and clad with aluminium. U metal (97.5%), aluminium (2.5%), graphite (~0.01%).

Chemical state: Neutral

Chemical form of radionuclides: U: Uranium metal.

Metals and alloys (%wt): 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.

Stainless steel.....	0
Other ferrous metals.....	0
Iron.....	
Aluminium.....	2.5
Beryllium.....	
Cobalt.....	
Copper.....	0
Lead.....	0
Magnox/Magnesium.....	0
Nickel.....	
Titanium.....	
Uranium.....	97.5
Zinc.....	0

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	Zircaloy/Zirconium	0
	Other metals	0
Organics (%wt):	-	
	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):	-	
	Inorganic ion exchange materials.	0
	Inorganic sludges and flocs	0
	Soil	0
	Brick/Stone/Rubble	0
	Cementitious material	0
	Sand	
	Glass/Ceramics	0
	Graphite	0.01
	Desiccants/Catalysts	
	Asbestos	0
	Non/low friable	
	Moderately friable	
	Highly friable	
	Free aqueous liquids	0
	Free non-aqueous liquids	0
	Powder/Ash	0
Inorganic anions (%wt):	-	

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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: Combustible metals comprise uranium.

Combustible metals	97.5
Low flash point liquids	0
Explosive materials	0
Phosphorus	0
Hydrides	0
Biological etc. materials	0
Biodegradable materials	
Putrescible wastes	0
Non-putrescible wastes	
Corrosive materials	0
Pyrophoric materials	0
Generating toxic gases	0
Reacting with water	0
Active particles	
Soluble solids as bulk chemical compounds	

Hazardous substances / non hazardous pollutants: None expected.

Acrylamide	
Benzene	
Chlorinated solvents	
Formaldehyde	
Organometallics	
Phenol	
Styrene	
Tri-butyl phosphate	
Other organophosphates	
Vinyl chloride	
Arsenic	
Barium	
Boron	

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.....

Complexing agents (%wt): No

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... 0

PACKAGING AND CONDITIONING

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 will be encapsulated using a cement grout. There are a total of 339 cans leading to 57 packages awaiting encapsulation.

Plant Name: Head End Cells / Waste Encapsulation Plant

Location: Harwell

Plant startup date: -

Total capacity (m^3/y incoming waste): ~24.0

Target start date for packaging this stream: -

Throughput for this stream (m^3/y incoming waste): ~24.0

Other information: Polymer encapsulation process in the Head End Cells is already operational. WEP is scheduled to start operations by 2018.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum (pre-cast annular)	100.0	0.033	0.4	57

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Likely container type comment:	-
Range in container waste volume:	Expect minimal variation.
Other information on containers:	316L Stainless Steel with cement annulus.
Likely conditioning matrix:	Pulverised Fly Ash / Ordinary Portland Cement
Other information:	-
Conditioned density (t/m³):	3.2
Conditioned density comment:	The volume and mass of waste per package are 0.04 m³ and 0.668 t. The volume and mass of polymer/grout per package are 0.36 m³ and 0.52 t.
Other information on conditioning:	-
Opportunities for alternative disposal routing:	

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source:	Fission products from fuel. The fissile material content per package is 4600.5 g U235, 0.9 g Pu239.
Uncertainty:	-
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 radionuclide data has been derived from FISPIN. The data represents the average activity of an element and has been derived by multiplying the data by the total number of elements (~11,500).
Other information:	Short-lived daughter products are not included in total alpha and total beta/gamma specific activities.

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	6.22E-04	B B 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			Tl 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	5.81E-06	B B 2		
Se 79	6.42E-06	B B 2			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85	1.67E-02	B B 2			Ra 228		8		
Rb 87		8			Ac 227	5.83E-06	B B 2		
Sr 90	6.93E-01	B B 2			Th 227	5.74E-06	B B 2		
Zr 93	6.88E-05	B B 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	1.79E-09	B B 2		
Nb 93m	1.58E-04	B B 2			Th 232		8		
Nb 94		8			Th 234	1.93E-01	B B 2		
Mo 93		8			Pa 231	1.11E-05	B B 2		
Tc 97		8			Pa 233	1.4E-06	B B 2		
Tc 99	2.91E-04	B B 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	2.41E-05	B B 2		
Ag 108m		8			U 235	8.89E-03	B B 2		
Ag 110m		8			U 236	7.45E-06	B B 2		
Cd 109		8			U 238	1.93E-01	B B 2		
Cd 113m	1.62E-05	B B 2			Np 237	1.4E-06	B B 2		
Sn 119m		8			Pu 236		8		
Sn 121m	1.51E-04	B B 2			Pu 238	1.19E-06	B B 2		
Sn 123		8			Pu 239	4.9E-02	B B 2		
Sn 126	5.23E-04	B B 2			Pu 240	1.89E-05	B B 2		
Sb 125	1.43E-07	B B 2			Pu 241		8		
Sb 126	7.32E-05	B B 2			Pu 242		8		
Te 125m	3.58E-08	B B 2			Am 241		8		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	3.5E-09	B B 2			Cm 242		8		
Cs 135	2.22E-05	B B 2			Cm 243		8		
Cs 137	7.65E-01	B B 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	5.39E-04	B B 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	3.66E-02	B B 2			Other a				
Eu 152	4.74E-06	B B 2			Other b/g				
Eu 154	9.03E-07	B B 2			**Total a**	**2.51E-01**	**B B 2**	**0**	
Eu 155	3.19E-04	B B 2			**Total b/g**	**1.71E+00**	**B B 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