WASTE STREAM 8A05 Empty Uranium Hexafluoride Containers

SITE Capenhurst

SITE OWNER Urenco

WASTE CUSTODIAN Urenco Nuclear Stewardship

WASTE TYPE LLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m³
Future arisings -	1.4.2028 - 31.3.2053.....	1776.0 m³
Total future arisings:		1776.0 m³
Total waste volume:		1776.0 m³

Comment on volumes: Current forecast for operation of LCF plant is 25 years from 2028. The waste volume is calculated from data given on design drawings of the containers and is the volume of the whole cylinders prior to any size reduction or treatment. Numbers of containers for future arisings is taken from current stored UF6 material and raw volumes are calculated from the size of the cylinders. At present the forecast date is 2028-2053 and arisings will be assumed to be linear.

Uncertainty factors on volumes:

Stock (upper):	x	Arisings (upper)	x 2.0
Stock (lower):	x	Arisings (lower)	x 0.5

WASTE SOURCE Future arisings will be from containers currently used to store hex which will be emptied during deconversion process.

PHYSICAL CHARACTERISTICS

General description: The waste consists of steel containers internally contaminated with traces of depleted, natural and enriched uranium as UF6/UF4/UO2F2. No items require special handling.

Physical components (%vol): Steel containers (> 99.9% of gross volume) plus residual contents (<0.1%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.71

Comment on density: The density is assumed from calculated data.

CHEMICAL COMPOSITION

General description and components (%wt): Steel (>99%), UF6/UF4/UO2F2 (<1%).

Chemical state: Acid

Chemical form of radionuclides:
C-14: Unknown.
Tc-99: Present as TcO2.
I-129: Unknown.
Ra: Unknown.
Th: Present as ThO2, ThO2F2, ThF4.
U: Present as UF6/UF4/UO2F2.
Np: Present as NpO2/NpO2F2.

Metals and alloys (%wt): Metal cylinders. Approximate dimensions 1m x 0.3m diameter, thickness 6mm. Future arisings will be made up of other sizes of cylinders but composition etc. will be the same.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	>99.9	mild steel 100%	100.0
Iron.....	0		
Aluminium.....			
Beryllium.....	0		
Cobalt.....	0		

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Copper		
Lead	0	
Magnox/Magnesium	0	
Nickel		
Titanium		
Uranium	<0.10	Present as UF6/UF4/UO2F2 proportions unknown.
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	0		
Fuel	0		
Asphalt/Tarmac (cont.coal tar)	0		
Asphalt/Tarmac (no coal tar)	0		
Bitumen	0		
Others	0		
Other organics	0		

Other materials (%wt): No other materials are present.

	(%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			
Graphite	0		
Desiccants/Catalysts	0		

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Asbestos	0
Non/low friable	0
Moderately friable	0
Highly friable	0
Free aqueous liquids	0
Free non-aqueous liquids	0
Powder/Ash	0

Inorganic anions (%wt): Fluorides will be present. Other inorganic anions may be present in trace quantities.

	(%wt)	Type(s) and comment
Fluoride	<0.10	
Chloride	<0.01	
Iodide	<0.01	
Cyanide	NE	
Carbonate	<0.01	
Nitrate	<0.01	
Nitrite	NE	
Phosphate	<0.01	
Sulphate	<0.01	
Sulphide	<0.01	

Materials of interest for waste acceptance criteria: Fluorides are present in the waste as stored, although washing and decontamination before disposal will remove this material.

	(%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	
Corrosive materials	0	
Pyrophoric materials	0	
Generating toxic gases	<1.0	<1%
Reacting with water	0	
Higher activity particles	0	
Soluble solids as bulk chemical compounds	0	

Hazardous substances / non hazardous pollutants: Toxic metals may be present in trace quantities, estimation is not possible without analysis.

UF6, UF4 and UO2F2 (<1 wt%).

	(%wt)	Type(s) and comment
Acrylamide	0	

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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	<1.0
Electronic Electrical Equipment (EEE)	
EEE Type 1	0
EEE Type 2	0
EEE Type 3	0
EEE Type 4	0
EEE Type 5	0

Complexing agents (%wt): No

	(%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: . No

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TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment	On-site	100.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various	On-site	100.0
None		

Comment on planned treatments: After on site washing the cylinders will be sent for metals recycling - could be further decontamination or melting. For stocks recently disposed of, melting was the chosen option (so 100% given). No final decisions have been made on the future arisings as yet.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository		
Expected to be consigned to a Landfill Facility	1.0	~1.0
Expected to be consigned to an On-Site Disposal Facility	99.0	~7.8
Expected to be consigned to an Incineration Facility		
Expected to be consigned to a Metal Treatment Facility		
Expected to be consigned as Out of Scope		
Expected to be recycled / reused		
Disposal route not known		

Classification codes for waste expected to be consigned to a landfill facility: Secondary wastes from processing.

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be consigned to an On-Site Disposal Facility			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be consigned as Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Opportunities for alternative disposal routing: -

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

Waste Packaging for Disposal:

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Container	Stream volume %	Waste loading m³	Number of packages
1/3 Height IP-1 ISO			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO			
1/2 Height IP-2 Disposal/Re-usable ISO			
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: Final disposal route will depend on the success of the metals recycling process.

Waste Planned for Disposal at the LLW Repository: (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: -

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: Contamination by uranium and daughters, with the possibility of Tc-99 in some of the containers.

Uncertainty: The specific activty data was measured for cylinders now disposed of. The future arisings have not yet been sampled so the existing data is assumed to apply. The accuracy is good for the measured data.

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: Samples of 10% of the previous stocks of containers (now disposed of) have been analysed and this data has been used to calculate the specific activity for the existing containers and future arisings.

Other information: -

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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					Gd 153				
Be 10					Ho 163				
C 14			~7.45E-10	C C 1	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210				
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226			~8.94E-09	C C 1
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93					Th 228			~1.27E-08	C C 1
Nb 91					Th 229				
Nb 92					Th 230			~1.15E-07	C C 1
Nb 93m					Th 232			~1.49E-09	C C 1
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99			~4.45E-07	C C 1	U 232			~3.65E-08	C C 1
Ru 106					U 233			~2.1E-07	C C 1
Pd 107					U 234			~1.21E-05	C C 1
Ag 108m					U 235			~5.14E-07	C C 1
Ag 110m					U 236			~1.65E-07	C C 1
Cd 109					U 238			~3.92E-06	C C 1
Cd 113m					Np 237			~2.16E-08	C C 1
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			~4.26E-07	C C 1	Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137					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					**Total a**	**0**		**~1.71E-05**	**C C 2**
Eu 155					**Total b/g**	**0**		**~8.72E-07**	**C C 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