

**WASTE STREAM****8A30****UCP Cemented RRF Concentrate****SITE** Capenhurst**SITE OWNER** Urenco**WASTE CUSTODIAN** URENCO Chemplants Ltd**WASTE TYPE** LLW**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2049.....	~1071.0 m <sup>3</sup>
	1.4.2050 - 31.3.2055.....	~~300.0 m <sup>3</sup>
Total future arisings:		1371.0 m <sup>3</sup>
Total waste volume:		1371.0 m <sup>3</sup>

Comment on volumes: Arisings related to cemented waste concentrate from the Residue Recovery Facility (RRF). This is estimated as 170 x 210 litre cemented drums per year over a 30 year operational period plus ca. 400 x 210 litre cemented drums per year over a 3.5 year period of post operational clean out metal decontamination. Metal decontamination and cylinder washing produces liquors for uranium and water recovered in the RRF. This will produce waste concentrate for cement solidification. Quantities of cemented waste will depend on annual outage and POCO decontamination.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.25  
 Stock (lower): x Arisings (lower) x 0.75

**WASTE SOURCE** Waste concentrate from treatment of cylinder wash and decontamination liquor after uranium and water recovery that is cement solidified.

**PHYSICAL CHARACTERISTICS**

General description: 210-litre (lost paddle) cemented waste concentrate drums. Cylinder wash and decontamination liquor that has been subject to uranium and water recovery then cement solidified.

Physical components (%wt): Drum and lost paddle = 20%. Cemented waste concentrate = 80%.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~1.9

Comment on density: Density includes weight of drum and lost paddle and should be consistent between drums.

**CHEMICAL COMPOSITION**

General description and components (%wt): Drum and lost paddle = 20%. Cemented waste concentrate = 80%.

Chemical state: Alkali

Chemical form of radionuclides:  
 H-3: N/A  
 C-14: N/A  
 Cl-36: N/A  
 Se-79: N/A  
 Tc-99: Trace quantities present as Tc(IV) as TcO<sub>2</sub> and Tc(VII) as pertechnetate.  
 I-129: N/A  
 Ra: N/A  
 Th: Thorium nitrate  
 U: U308, UO<sub>2</sub>F<sub>2</sub> and uranyl nitrate  
 Np: Trace quantities potentially in nitrate form  
 Pu: Trace quantities potentially in nitrate form

Metals and alloys (%wt): -

Stainless steel.....		
Other ferrous metals.....	20.0	Mild steel of drum and lost paddle
Iron.....		
Aluminium.....		
Beryllium.....		

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	Cobalt.....	
	Copper.....	
	Lead.....	
	Magnox/Magnesium.....	
	Nickel.....	
	Titanium.....	
	Uranium.....	<0.01
	Zinc.....	
	Zircaloy/Zirconium.....	
	Other metals.....	
Organics (%wt):	None	
	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.....	0
Other materials (%wt):	-	
	Inorganic ion exchange materials.	0
	Inorganic sludges and flocs.....	0
	Soil.....	0
	Brick/Stone/Rubble.....	0
	Cementitious material.....	80.0
	Sand.....	0
	Glass/Ceramics.....	0
	Graphite.....	0
	Desiccants/Catalysts.....	0
	Asbestos.....	0
	Non/low friable.....	
	Moderately friable.....	

Cemented waste form

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	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	
Inorganic anions (%wt):	Trace quantities may be present	
	Fluoride.....	<1.0                      Uranyl fluoride
	Chloride.....	0
	Iodide.....	0
	Cyanide.....	0
	Carbonate.....	<0.10                      Traces of uranyl carbonate
	Nitrate.....	<1.0                      Uranyl nitrate
	Nitrite.....	0
	Phosphate.....	<0.10                      Traces of uranyl phosphate
	Sulphate.....	0
	Sulphide.....	0
Materials of interest for waste acceptance criteria:	Drummed and cemented Low Activity LLW with low leachability suitable for Radioactive Substances Regulated landfill disposal	
	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.....	0
	Reacting with water.....	0
	Active particles.....	0
	Soluble solids as bulk chemical compounds.....	0
Hazardous substances / non hazardous pollutants:	No hazardous substances / non-hazardous pollutants (cemented waste form with low leachability potential), but noting the presence of chromium in dry cement powder	
	Acrylamide.....	
	Benzene.....	0
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	0
	Styrene.....	
	Tri-butyl phosphate.....	0

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Other organophosphates.....  
 Vinyl chloride..... 0  
 Arsenic..... 0  
 Barium.....  
 Boron..... 0  
 Cadmium..... 0  
 Caesium.....  
 Selenium..... 0  
 Chromium..... P  
 Molybdenum..... 0  
 Thallium.....  
 Tin..... 0  
 Vanadium..... 0  
 Mercury compounds.....  
 Others..... 0

Trace constituent from OPC in the cemented waste

**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.....

**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 Size reduction Decay storage Recycling / reuse Other / various None	On-site	100.0

Comment on planned treatments:

Following evaporation and reverse osmosis treatment the remaining waste concentrate will be cement solidified 210 litre lost paddle drums.

**WASTE STREAM****8A30****UCP Cemented RRF Concentrate****Disposal Routes:**

Disposal Route	Stream volume %
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	100.0

**Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):**

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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			

**Waste Packaging for Disposal:** (Not applicable to this waste stream)

Container	Stream volume %	Waste loading m <sup>3</sup>	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: Drums of cemented concentrate consigned on pallets for LLW disposal to a RSR permitted landfill.

**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: -

Potential for the waste to contain discrete items: -

**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: -

**WASTE STREAM****8A30****UCP Cemented RRF Concentrate****RADIOACTIVITY**

Source:	Cemented waste concentrate from Uranium and water recovery in the RRF
Uncertainty:	Based on facility design assessment and not yet underpinned by operational experience. Arising during POCO not yet underpinned. Cemented concentrate is limited to NatU as a RU concentrate will not be produced.
Definition of total alpha and total beta/gamma:	Initial decay chain and short-lived (i.e. less than three month) decay products of U-238 not listed and expected to be in equilibrium with U-238.
Measurement of radioactivities:	Currently theoretical estimate (TMF not yet operational)
Other information:	Other Uranium series decay products not present as the source is chemically purified Uranium.

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3					Gd 153				
Be 10					Ho 163				
C 14					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				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93					Th 228		~~5.53E-06	BB	2
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99			~~1.68E-06	BB	2		~~7.45E-08	BB	2
Ru 106					U 232				
Pd 107					U 233				
Ag 108m					U 234		~~9.14E-06	BB	2
Ag 110m					U 235		~~3.97E-07	BB	2
Cd 109					U 236		~~9.95E-07	BB	2
Cd 113m					U 238		~~2.02E-05	BB	2
Sn 119m					Np 237		~~1.92E-11	BB	2
Sn 121m					Pu 236				
Sn 123					Pu 238				
Sn 126					Pu 239				
Sb 125					Pu 240				
Sb 126					Pu 241		~~1.82E-13	BB	2
Te 125m					Pu 242				
Te 127m					Am 241				
I 129					Am 242m				
Cs 134					Am 243				
Cs 135					Cm 242				
Cs 137					Cm 243				
Ba 133					Cm 244				
La 137					Cm 245				
La 138					Cm 246				
Ce 144					Cm 248				
Pm 145					Cf 249				
Pm 147					Cf 250				
Sm 147					Cf 251				
Sm 151					Cf 252				
Eu 152					Other a				
Eu 154					Other b/g				
Eu 155					<b>Total a</b>	<b>0</b>	<b>~~3.63E-05</b>	<b>BB</b>	<b>2</b>
					<b>Total b/g</b>	<b>0</b>	<b>~~1.68E-06</b>	<b>BB</b>	<b>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