

<b>WASTE STREAM</b>	<b>8A101</b>	<b>Centrifuge Plant Decommissioning</b>
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**SITE** Capenhurst

**SITE OWNER** Urenco

**WASTE CUSTODIAN** URENCO

**WASTE TYPE** LLW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	<65.0 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2020.....	40.0 m <sup>3</sup>
	1.4.2020 - 31.3.2030.....	120.0 m <sup>3</sup>
	1.4.2030 - 31.3.2100.....	NE m <sup>3</sup>
Total future arisings:		160.0 m <sup>3</sup>
Total waste volume:		225.0 m <sup>3</sup>

Comment on volumes: -

Uncertainty factors on volumes:

Stock (upper):	x 1.0	Arisings (upper)	x 1.2
Stock (lower):	x 1.0	Arisings (lower)	x 0.8

**WASTE SOURCE** General plant decommissioning.

**PHYSICAL CHARACTERISTICS**

General description: Uranium contaminated material associated with decommissioning of centrifuge plants. There are no large items.

Physical components (%vol): Aluminium (90%), steel (3%), concrete (7%).

Sealed sources: The waste does not contain sealed sources.

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

Comment on density: The material will be mainly aluminium (density 2.7t/m<sup>3</sup>) with some heavier metals, mainly steel.

**CHEMICAL COMPOSITION**

General description and components (%wt): Aluminium (86.5%), steel (8.5%), concrete (5%).

Chemical state: Neutral

Chemical form of radionuclides: U: UO<sub>2</sub>F<sub>2</sub> and UF<sub>4</sub>.

Metals and alloys (%wt): Mainly pipework 2 mm thickness. Some valve and pump components may be up to 100 mm thick. Aluminium has an average thickness of 10 mm.

Stainless steel.....	3.5
Other ferrous metals.....	5.0
Iron.....	
Aluminium.....	86.5
Beryllium.....	
Cobalt.....	
Copper.....	TR
Lead.....	
Magnox/Magnesium.....	
Nickel.....	
Titanium.....	
Uranium.....	<0.10
Zinc.....	
Zircaloy/Zirconium.....	

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	Other metals.....	
Organics (%wt):	-	
	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.....	5.0
	Sand.....	
	Glass/Ceramics.....	
	Graphite.....	0
	Desiccants/Catalysts.....	
	Asbestos.....	0
	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	
Inorganic anions (%wt):	The fluoride is from uranyl fluoride as deposit on aluminium and other metal surfaces.	

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Fluoride.....	0.01
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.....	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
Active particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances /  
non hazardous pollutants:

Uranium levels expected to be below 0.1%, typically 0.05% and will be below the level set for hazardous waste.

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

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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

No complexing agents are likely to be present.

**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		<100.0

Comment on planned treatments:

Metallic waste will likely be treated in a two step process - decontamination and if necessary, melting. As part of the decontamination and melting process a significant amount of size reduction may be required. Result will be some metals classed as non-radioactive / free release, the rest, VLLW contaminated and not requiring disposal at LLWR. Only a small fraction of waste will be highly contaminated and requiring disposal at LLWR. Where possible, components will be assessed for their reusability (for example pumps).

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Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	~10.0
Expected to be consigned to a Landfill Facility	<10.0
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	>80.0
Expected to be consigned as Out of Scope	
Expected to be recycled / reused	
Disposal route not known	

**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:**

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	~10.0	~15.6	2
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

**Waste Planned for Disposal at the LLW Repository:**

Container voidage: There will be some interstitial volume between drums in the ISO container. This volume can be filled with loose material.

Waste Characterisation Form (WCH): It is not yet determined if the waste meets LLWR's Waste Acceptance Criteria (WAC).

Current projections are that ~10% of waste from centrifuge decommissioning may go to LLWR. However, this may change pending the availability of new routes and analysis methods.

Waste consigned for disposal to LLWR in year of generation: Yes.

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:

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Inaccessible voidage: -

Other information: -

**RADIOACTIVITY**

Source: Uranium isotopes with associated daughter activity Th-234 and Pa-234.

Uncertainty: More information on specific activity will be available when more of the stream is monitored.

Definition of total alpha and total beta/gamma: Other beta/gamma are uranium daughter products. There is also the possibility that Tc-99 may be present on surfaces however at present this can not be quantified.

Measurement of radioactivities: Some initial work has been carried out by sampling the waste and chemically analysing the samples.

Other information: The activity is based on non-recycled uranium being processed. If recycled uranium is processed re-evaluation of the activity will be required. Short-lived daughters have been included as "other beta/gamma"; these are Pa-234 and Th-234.

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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				
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					U 232				
Ru 106					U 233				
Pd 107					U 234	2.4E-05	CC 2	2.4E-05	CC 2
Ag 108m					U 235	4.8E-07	CC 2	4.8E-07	CC 2
Ag 110m					U 236				
Cd 109					U 238	2.4E-05	CC 2	2.4E-05	CC 2
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					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	2.4E-05	CC 2	1.2E-06	CC 2
Eu 154					<b>Total a</b>	<b>4.85E-05</b>	<b>CC 2</b>	<b>4.85E-05</b>	<b>CC 2</b>
Eu 155					<b>Total b/g</b>	<b>2.4E-05</b>	<b>CC 2</b>	<b>1.2E-06</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