

WASTE STREAM	2N17	Legacy Drums (Bulk)
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SITE LLWR (near Drigg)

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN LLWR SLC Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	34.7 m ³
Total future arisings:		0 m ³
Total waste volume:		34.7 m ³
Comment on volumes:	-	

Uncertainty factors on volumes:	Stock (upper): x 1.2	Arisings (upper) x
	Stock (lower): x 0.8	Arisings (lower) x

WASTE SOURCE Historically, drums of waste from numerous sites were consigned to the LLWR for interim storage, prior to transfer to Sellafield Ltd for storage and/or processing. During a detailed provenance investigation carried out during the early stages of the project, sufficient evidence was identified to suggest that the Legacy Drum population arrived at the LLWR Site at some point during the 1960's. Subsequent investigations identified that the drums may also contain uranium fluoride-based wastes.

PHYSICAL CHARACTERISTICS

General description: There are 153 drums from an original inventory of 165, the other 12 of which will be transferred to Sellafield Limited and will be stored with their PCM, (Included as part of 2N03). Therefore, the waste stream covers the inventory of 153 drums only. The drums are 200 litre drums and contained various materials such as powders, sludges, plastics, cloths, soft bagged waste, unknown liquids, cloths and concrete (annulus). The drums were stripped down for sampling purposes, the outer drum was removed to reveal the concrete annulus of some of the drums. Other drums were subject to intrusive sampling with various tools and equipment.

Physical components (%vol): Overall composition: Metals (3%), Plastics (3%), Wood (4%), Concrete (60%), various types of powders found within the drums (30%). 153 drums sampled found green powder 82%, brown powder 4.5%, yellow powder 3%, black sludge 1%, grey powder 0.5%, discrete bags of green and yellow powder 0.5%, PVC Sheeting, rags, fabric, lab waste and empty sample pots 5%, metallic waste, rubble and plant items 3%, wooden waste 0.5%.

Sealed sources: The waste does not contain sealed sources. N/A

Bulk density (t/m³): ~1.01

Comment on density: Bulk density is based on an estimate of the total waste mass divided by the total waste volume.

CHEMICAL COMPOSITION

General description and components (%wt): Metals (3%), Plastics (3%), Wood (4%), Concrete (60%), various types of powders found within the drums (30%).

Chemical state: Alkali

Chemical form of radionuclides: Tc-99: Present.
 Ra: Present as metals, oxides or other forms.
 Th: Present as metals, oxides or other forms.
 U: Oxides, fluorides.
 Np: Present as metals, oxides or other forms.
 Pu: Nitrate, sulphide, fluoride or mixed oxides.

Metals and alloys (%wt): -

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....			
Other ferrous metals.....	~3.0	Mild steel drums and misc. plant items/ tools.	
Iron.....			
Aluminium.....			
Beryllium.....			
Cobalt.....			
Copper.....			
Lead.....			
Magnox/Magnesium.....			
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....			
Zircaloy/Zirconium.....			
Other metals.....			

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~3.0		
Paper, cotton.....			
Wood.....	~3.0	Wooden waste within drums.	
Halogenated plastics			
Total non-halogenated plastics.....	~4.0		
Condensation polymers.....			
Others.....			
Organic ion exchange materials....			
Total rubber.....			
Halogenated rubber			
Non-halogenated rubber.....			
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....			

Other materials (%wt): -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..			
Inorganic sludges and flocs.....			
Soil.....			
Brick/Stone/Rubble.....			
Cementitious material.....	~60.0	Enacapsulant material within the drums	
Sand.....			
Glass/Ceramics.....			
Graphite.....			
Desiccants/Catalysts.....			
Asbestos.....			
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....			
Free non-aqueous liquids.....			
Powder/Ash.....	~30.0	Various types of powders within the drums.	
Inorganic anions (%wt):	-		

	(%wt)	Type(s) and comment
Fluoride.....	~10.0	Uranium fluorides (UF4, UF6 and UO2F2).
Chloride.....	NE	
Iodide.....	NE	
Cyanide.....	NE	
Carbonate.....	NE	
Nitrate.....	NE	
Nitrite.....	NE	
Phosphate.....	NE	
Sulphate.....	NE	
Sulphide.....	NE	

Materials of interest for waste acceptance criteria: Uranium drums contain UFx compounds

	(%wt)	Type(s) and comment
Combustible metals.....	NE	
Low flash point liquids.....	NE	
Explosive materials.....	NE	
Phosphorus.....	NE	
Hydrides.....	NE	
Biological etc. materials.....	NE	
Biodegradable materials.....	NE	
Putrescible wastes.....	NE	

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Non-putrescible wastes.....	NE
Corrosive materials.....	NE
Pyrophoric materials.....	NE
Generating toxic gases.....	NE
Reacting with water.....	NE
Higher activity particles.....	NE
Soluble solids as bulk chemical compounds.....	NE

Hazardous substances / Uranium drums contain UFx compounds.
non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	NE	
Benzene.....	NE	
Chlorinated solvents.....	NE	
Formaldehyde.....	NE	
Organometallics.....	NE	
Phenol.....	NE	
Styrene.....	NE	
Tri-butyl phosphate.....	NE	
Other organophosphates.....	NE	
Vinyl chloride.....	NE	
Arsenic.....	NE	
Barium.....	NE	
Boron.....	NE	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	NE	
Caesium.....	NE	
Selenium.....	NE	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....	NE	
Tin.....	NE	
Vanadium.....	NE	
Mercury compounds.....	NE	
Others.....	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	NE	
EEE Type 2.....	NE	
EEE Type 3.....	NE	
EEE Type 4.....	NE	
EEE Type 5.....	NE	

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Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....	NE	
DPTA.....	NE	
NTA.....	NE	
Polycarboxylic acids.....	NE	
Other organic complexants.....	NE	
Total complexing agents.....	NE	

Potential for the waste to contain discrete items: Not yet determined. Treatment/ conditioning and disposal route to be determined to understand if discrete items are an issue.

PACKAGING AND CONDITIONING

Conditioning method: To be determined-not yet known.

Plant Name: To be determined-not yet known.

Location: To be determined-not yet known

Plant startup date: To be determined-not yet known.

Total capacity (m³/y incoming waste): *

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): NE

Other information: BAT/ optioneering for the legacy drums has been re-instigated to enable delivery of an NDA Gate A report. A decision will be made (~Autumn 2022) whether we move into the credible options assessment for the 2N17 stream.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	Not specified	NE	NE	NE	

Likely container type comment: To be determined -not yet known.

Range in container waste volume: To be determined -not yet known.

Other information on containers: Investigations are ongoing into suitable containers, should the drums require transportation off the LLWR site. UN Salvage drums are one option that are being reviewed for suitability.

Likely conditioning matrix: Other

Other information: To be determined -not yet known.

Conditioned density (t/m³): NE

Conditioned density comment: To be determined -not yet known.

Other information on conditioning: To be determined -not yet known.

Opportunities for alternative disposal routing: Not yet determined

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

RADIOACTIVITY

Source:	The waste is a result of historic processes from external sites prior to transfer to the LLWR. It is believed that the drums originated from Westinghouse, Springfields and were generated by the conversion of uranium hexafluoride.
Uncertainty:	Specific activities have been based on the sampling results of each drum. Drums have been grouped based on their provenance and characteristics. Phys-chem analysis of the full population of drums has not been carried out.
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:	An intrusive sampling campaign took place and samples were dispatched to a lab for full characterisation analysis.
Other information:	BAT/ optioneering for the legacy drums has been re-instigated to enable delivery of an NDA Gate A report. A decision will be made (~Autumn 2022) whether we move into the credible options assessment for the 2N17 stream.

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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					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					Ti 204				
Mn 54					Pb 205				
Fe 55					Pb 210	~1.65E-05	AA 1		
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	~7.51E-06	AA 1		
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	~3.95E-03	AA 1			Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230	~2.82E-04	AA 1		
Nb 93m					Th 232	~5.22E-06	AA 1		
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99	~1.13E-02	AA 1			U 232				
Ru 106					U 233	~2.01E-06	AA 1		
Pd 107					U 234	~1.34E-03	AA 1		
Ag 108m					U 235	~5.74E-05	AA 1		
Ag 110m					U 236	~3.26E-05	AA 1		
Cd 109					U 238	~1.19E-03	AA 1		
Cd 113m					Np 237	~2.19E-03	AA 1		
Sn 119m					Pu 236				
Sn 121m					Pu 238	~4.12E-06	AA 1		
Sn 123					Pu 239	~2.05E-04	AA 1		
Sn 126					Pu 240	~2.05E-04	AA 1		
Sb 125					Pu 241	~7.63E-05	AA 1		
Sb 126					Pu 242	~4.55E-06	AA 1		
Te 125m					Am 241	~1.28E-05	AA 1		
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137	~7.49E-06	AA 1			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	~5.54E-03	AA 1	0	
Eu 155					Total b/g	~1.54E-02	AA 1	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