WASTE STREAM 2N18 Low Level Waste Drums

SITE	LLWR (near Drigg)
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	LLWR SLC Limited
WASTE TYPE	LLW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	4.0 m³
Total future arisings:		0 m³
Total waste volume:		4.0 m³

Comment on volumes: Waste associated with the 2N18 stream has been generated and is currently being stored pending disposal.

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 LLW Disposal. They have been stored on the LLWR site for ~30 years. There is a total of ten x 400 litre drums. Re-characterisation of the drums has enabled 7 of them to be re-classified as VLLW (3 remain as LLW). This waste stream covers the full inventory of ten drums.

PHYSICAL CHARACTERISTICS

General description:	The drums contained various materials such as sludges (dry), soft bagged waste, and broken lab ware (glass) inside plastic tubs. Each drum was opened, investigated and the contents sampled. Other than processing of the waste within the drums and obtaining samples, there have been no physical or chemical changes.
Physical components (%vol):	Each drum is 0.4m3 (400 litre). Metal accounts for ~ 10%vol. Plastic (non-halogenated) accounts for 50%vol. Soil/ rubble/ dried sludge accounts for 20%vol. Glass (broken lab ware) accounts for 10%vol. Cellulosics 10%vol.
Sealed sources:	The waste does not contain sealed sources. N/A
Bulk density (t/m³):	~0.36
Comment on density:	Bulk density is based on an estimate of the total waste mass (1.4t) divided by the total waste volume (4m3).

CHEMICAL COMPOSITION

General description and components (%wt):	Metals (19%), Plastics (PPE and plastic labware) (15%), rubble/cement (48%), glass (3%), paper/cotton (5%), wood (10%).
Chemical state:	Neutral
Chemical form of radionuclides:	H-3: Present - Tritium oxide. C-14: Present. Cl-36: Not present. Se-79: Not present. Tc-99: Present. I-129: Not present. Th: Thorium oxide (powder). U: Uranium oxide. Np: Not present. Pu: Plutonium oxide.
Metals and alloys (%wt):	No bulk items in this wastestream. 19% (%wt) of metal present as sheet (representative of the 400 litre drum).

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....			
Other ferrous metals.....	~19.0	Mild steel 400 litre drums.	
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 cellulosics.....	~15.0	plastic (lab bottles and polystyrene)	
Paper, cotton.....	~5.0	Paper wipes	
Wood.....	10.0	wood shavings	
Halogenated plastics			
Total non-halogenated plastics.....	~15.0	PVC wrapping and sheets	
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.....	~30.0		
Cementitious material.....	~18.0		
Sand.....			
Glass/Ceramics.....	~3.0	lab ware (glass)	
Graphite.....			
Desiccants/Catalysts.....			
Asbestos.....			
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....			
Free non-aqueous liquids.....			
Powder/Ash.....			

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
Fluoride.....		
Chloride.....		
Iodide.....		
Cyanide.....		
Carbonate.....		
Nitrate.....		
Nitrite.....		
Phosphate.....		
Sulphate.....		
Sulphide.....		

Materials of interest for waste acceptance criteria: -

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

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Corrosive materials.....

Pyrophoric materials.....

Generating toxic gases.....

Reacting with water.....

Higher activity particles.....

Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants: N/A

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....		
Boron (in Boral).....		
Boron (non-Boral).....		
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.....		

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Complexing agents (%wt): No

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

Potential for the waste to contain discrete items: . Yes - 1 x pump in one of the LLW drums (within discrete item limit).

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		
Recyling / reuse		
Other / various		
None	Off-site	100.0

Comment on planned treatments: 7 of the 10 LLW drums will be consigned to landfill for disposal. 3 of the 10 drums will be disposed of as LLW in the Vault.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	30.0	~0.36
Expected to be consigned to a Landfill Facility	70.0	~0.36
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		

Classification codes for waste expected to be consigned to a landfill facility: 7 x 400 litre drums containing various wastes (labware, PPE, dried sludge).

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: -

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Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at LLWR	Authorised landfill	75.0	2023	High	Drums have been sampled and some of them have been deemed suitable for disposal at an authorised landfill. Funding required to facilitate disposal.

Waste Packaging for Disposal:

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	30.0	1.2	1

Other information: The 3 x LLW drums will be co-loaded with other LLW generated on the LLWR site for vault disposal.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Voidage anticipated to be <20%. Drums will be packaged in a TC01 with other LLW generated on the LLWR site (from other waste streams). Lids to be removed once emplaced in a TC01 disposal container to ensure the free flow of grout during grouting operations.

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste does not have a current WCH.

WCH is in progress.

Waste consigned for disposal to LLWR in year of generation: No. Drums were consigned to LLWR as LLW circa 1980's and have been stored since then. The drums were sampled and analysed in 2018 and 7 of the drums have been recharacterised as VLLW.

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: Historic processes from external sites prior to transfer to the LLWR.

Uncertainty: Specific activites have been based on the sampling results of each drum.

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: -

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	~2.32E-04	B B 2			Gd 153				
Be 10					Ho 163				
C 14	~3.87E-03	B B 2			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	~2.58E-07	B B 2		
Co 60	~1.38E-07	B B 2			Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	~8.25E-08	B B 2		
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	~1.36E-08	B B 2			Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234	~1.64E-05	B B 2		
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99	~4.36E-07	B B 2			U 232				
Ru 106					U 233				
Pd 107					U 234	~1.25E-05	A A 2		
Ag 108m					U 235	~7.44E-07	A A 2		
Ag 110m					U 236				
Cd 109					U 238	~1.83E-06	A A 2		
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238	~6.37E-10	B B 2		
Sn 123					Pu 239	~2E-09	A A 2		
Sn 126					Pu 240	~1.26E-08	A A 2		
Sb 125					Pu 241	~1.19E-08	B B 2		
Sb 126					Pu 242				
Te 125m					Am 241	~6.43E-09	A A 2		
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	~2.2E-09	B B 2			Cm 242				
Cs 135					Cm 243				
Cs 137	~2.88E-08	B B 2			Cm 244	~4.25E-11	B B 2		
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	~9.51E-08	B B 2			Other b/g				
Eu 154	~2.35E-08	B B 2			**Total a**	**1.52E-05**	**A A 2**	**0**	
Eu 155	~2.11E-09	B B 2			**Total b/g**	**~4.12E-03**	**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