

WASTE STREAM	2N04	LLW from PCM Operations
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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.....	97.5 m ³
Future arisings -	1.4.2022 - 31.3.2023.....	0 m ³
Total future arisings:		0 m ³
Total waste volume:		97.5 m ³
Comment on volumes:	No future arisings as all waste has been generated and is awaiting consignment.	
Uncertainty factors on volumes:	Stock (upper): x 1.3	Arisings (upper) x
	Stock (lower): x 0.7	Arisings (lower) x

WASTE SOURCE The waste primarily comprises of soft waste (predominantly PPE) and hard wastes (contaminated building materials) generated during decontamination and POCO activities in the PCM facilities on the LLWR site.

PHYSICAL CHARACTERISTICS

General description: Waste that has been generated and deemed not suitable for any of the Diversion Services i.e metals, wood, plastics, motors, pumps, cables, rubble, dust. Only changes to the waste are size reduction and painting of internal metallic waste surfaces (reactive metals).

Physical components (%wt): Metals (24.79%), Organics such as paper, wood, plastics, bitumen (16.93%), Others such as cementitious material, rubble, glass (58.28%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.6

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 (24.79%), Organics such as paper, wood, plastics, bitumen (16.93%), Others such as cementitious material, rubble, glass (58.28%).

Chemical state: Alkali

Chemical form of radionuclides: H-3: Trace quantities could be present as organically bound or free tritium.
C-14: Not expected to be present.
Cl-36: Not expected to be present.
Se-79: Not expected to be present.
Tc-99: Not expected to be present.
I-129: Not expected to be present.
Ra: Could be present as metals, oxides or other forms.
Th: Could be present as metals, oxides or other forms.
U: Oxides, fluorides.
Np: Could be present as metals, oxides or other forms.
Pu: Nitrate, sulphide, fluoride or mixed oxides.

Metals and alloys (%wt): Larger items such as fork lift trucks and drum handling equipment will be size reduced as part of the waste export process. Items will vary in size and size reduction requirements will be influenced by the waste route. Ventilation ductwork comprising of mild steel, galvenised (zinc) steel (~6%wt, ~3mm thickness).

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~0.78	Grades not known.	
Other ferrous metals.....	~23.9	Grades not known.	
Iron.....			
Aluminium.....	~0.01	Grades not known.	
Beryllium.....			
Cobalt.....			
Copper.....	~0.09	Predominantly in electrical equipment.	
Lead.....	TR	Trace could be present in redundant equipment.	
Magnox/Magnesium.....			
Nickel.....	TR	Trace could be present in redundant equipment.	
Titanium.....			
Uranium.....			
Zinc.....	TR	Trace could be present in redundant equipment.	
Zircaloy/Zirconium.....			
Other metals.....	~		
Organics (%wt):	16.93%wt organics - breakdown provided below.		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~2.9		
Paper, cotton.....	~2.6		
Wood.....	~0.35		
Halogenated plastics	~6.5	Including PVC.	
Total non-halogenated plastics.....	~0.65		
Condensation polymers.....	~0.08		
Others.....	~0.57	Various including polypropylene and polyethene.	
Organic ion exchange materials....	NE		
Total rubber.....	~0.32		
Halogenated rubber	~0.32	Pessimistically assumed to be halogenated.	
Non-halogenated rubber.....			
Hydrocarbons.....	~6.5		
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....	~6.5		
Others.....			
Other organics.....			
Other materials (%wt):	58.28%wt - breakdown provided below		

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	~0.08		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	~0.04		
Cementitious material.....	~58.1	Concrete.	
Sand.....			
Glass/Ceramics.....	~0.09	Glass and fibreglass.	
Graphite.....			
Desiccants/Catalysts.....	0		
Asbestos.....			
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....		Only for onsite discharge.	
Free non-aqueous liquids.....			
Powder/Ash.....	NE	Dust waste may be diverted from the PCM route.	

Inorganic anions (%wt): Not expected to be added - only physical processes are being applied for decontamination.

	(%wt)	Type(s) and comment
Fluoride.....	NE	
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: Battery acid, brake & hydraulic fluids from redundant Fork Lift Trucks may be contaminated, but should be suitable for incineration. The scabbled concrete will be in a powder form. Hollow bodies are present, e.g. pumps and hydraulic fluid chambers.

	(%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.....	P	
Putrescible wastes.....	NE	

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Non-putrescible wastes.....	P	Paper, wood.
Corrosive materials.....	NE	
Pyrophoric materials.....	NE	
Generating toxic gases.....	NE	
Reacting with water.....	NE	
Higher activity particles.....	NE	Possible, but unlikely due to ILW/LLW segregation.
Soluble solids as bulk chemical compounds.....	NE	

Hazardous substances /
non hazardous pollutants: Not expected

	(%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).....	NE	
Boron (non-Boral).....	NE	
Cadmium.....	NE	
Caesium.....	NE	
Selenium.....	NE	
Chromium.....	P	Could be present in stainless steel alloy.
Molybdenum.....	P	Could be present in stainless steel alloy.
Thallium.....	NE	
Tin.....	NE	
Vanadium.....	NE	
Mercury compounds.....	NE	
Others.....	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	P	~415 units (cameras, computer equipment etc.)
EEE Type 2.....	P	~50 units (transformer components)
EEE Type 3.....	P	~47 electric drill components
EEE Type 4.....	0	
EEE Type 5.....	0	

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Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....	0	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids.....	0	Not estimated.
Other organic complexants.....	0	Not estimated.
Total complexing agents.....	0	

Potential for the waste to contain discrete items: Yes. Yes the waste will very likely contain discrete items including pieces of redundant equipment remaining after size reduction and waste segregation - there are not expected to be any discrete items that challenge the vault disposal WAC.

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: Consigned to on-site Vault for disposal.

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 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	~0.60

Classification codes for waste expected to be consigned to a landfill facility: -

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			

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Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at LLWR	Incineration	~5.0	2022	High	ion exchange resins - consigned for incineration.

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m ³	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	100.0	19.5	5

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: Voidage kept to a minimum but typical voidage will be kept to less than 20% in line with the WAC.

Waste Characterisation Form (WCH): The waste does not meet the LLWR's Waste Acceptance Criteria (WAC). The waste has a current WCH. Inventory information is consistent with the current WCH. Some WAC issues identified with some of the vault disposal containers (i.e. Reactive metals >10m2 and TPH content) - discussions have been held with the compliance team and WCVs are being prepared. Some items also require removal and will be consigned under the 2N03 stream.

Waste consigned for disposal to LLWR in year of generation: No. Typically 1-2 years following waste generation as there is little waste generated for LLW Disposal. Budget and resource constraints will also be a factor.

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: Waste has become contaminated through contact with PCM waste stored / processed in the buildings.

Uncertainty: Specific activities have been based on sample results for waste items or similar waste items or inferred from monitoring data where available. Specific activities by mass have been converted to specific activities by volume, so uncertainties in the volume estimates will also be carried over.

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: A number of characterisation methods have been used including; sampling, hand held monitoring and LRGS (for soft waste). The majority of measurement data used has been collected in the past two years.

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Other information:

Waste is present with a range of specific activities within the LLW category.

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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	-7.10E-10	CC 2			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	-8.56E-09	CC 2			Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55	-1.41E-11	CC 2			Pb 210	-4.65E-09	CC 2		
Co 60	-4.00E-12	CC 2			Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	-4.21E-09	CC 2		
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226	-4.88E-09	CC 2		
Kr 85					Ra 228	-6.65E-09	CC 2		
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93					Th 228	-1.34E-08	CC 2		
Nb 91					Th 229	-9.51E-12	CC 2		
Nb 92					Th 230	-4.38E-09	CC 2		
Nb 93m					Th 232	-1.62E-08	CC 2		
Nb 94					Th 234	-4.32E-10	CC 2		
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99	-2.69E-10	CC 2			U 232	-8.45E-11	CC 2		
Ru 106					U 233				
Pd 107					U 234	-7.42E-07	BB 2		
Ag 108m					U 235	-3.13E-08	BB 2		
Ag 110m					U 236	-6.08E-10	BB 2		
Cd 109					U 238	-8.45E-08	CC 2		
Cd 113m					Np 237	-2.54E-10	CC 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238	-5.12E-07	BB 2		
Sn 123					Pu 239	-2.35E-05	BB 2		
Sn 126					Pu 240	-1.77E-06	BB 2		
Sb 125					Pu 241	-1.64E-05	BB 2		
Sb 126					Pu 242	-3.28E-08	BB 2		
Te 125m					Am 241	-7.00E-06	BB 2		
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242	-1.07E-10	CC 2		
Cs 135					Cm 243				
Cs 137	-1.5E-07	CC 2			Cm 244	-2.32E-11	CC 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					Other b/g				
Eu 154					Total a	-3.38E-05	CC 2	0	
Eu 155					Total b/g	-1.66E-05	CC 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