WASTE STREAM 2D132 Plutonium Plants Initial/Interim Decommissioning: Processing Plants (PCM)

SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m³
Future arisings -	1.4.2022 - 31.3.2023.....	0 m³
	1.4.2023 - 31.3.2024.....	0 m³
	1.4.2024 - 31.3.2025.....	0 m³
	1.4.2025 - 31.3.2032.....	0 m³
	1.4.2032 - 31.3.2034.....	~211.8 m³
	1.4.2034 - 31.3.2038.....	~548.4 m³
	1.4.2038 - 31.3.2040.....	~62.4 m³
	1.4.2040 - 31.3.2045.....	~238.5 m³
	1.4.2045 - 31.3.2049.....	~66.0 m³
	1.4.2049 - 31.3.2058.....	~429.2 m³
	1.4.2058 - 31.3.2059.....	~69.1 m³
	1.4.2059 - 31.3.2060.....	~52.6 m³
	1.4.2060 - 31.3.2063.....	~64.3 m³
	1.4.2063 - 31.3.2066.....	~157.9 m³
	1.4.2066 - 31.3.2073.....	~249.5 m³
	1.4.2074 - 31.3.2095.....	~0 m³
	1.4.2095 - 31.3.2096.....	~32.9 m³
	1.4.2096 - 31.3.2106.....	~311.9 m³
Total future arisings:		2494.5 m³
Total waste volume:		2494.5 m³

Comment on volumes: Arisings are in line with current decommissioning programmes and strategy. Waste within this waste stream is generated from decommissioning projects which will commence at a future date. As a result of this, minimal characterisation of waste volumes and fingerprints has been carried out and hence there is a large uncertainty in the potential arisings. Preliminary assessments indicate that the volumes may vary from -30% to +200% for ILW.

Uncertainty factors on volumes:

Stock (upper):	x	Arisings (upper)	x 3.0
Stock (lower):	x	Arisings (lower)	x 0.7

WASTE SOURCE Dismantling of plutonium process plants.

PHYSICAL CHARACTERISTICS

General description: Plant and equipment, internal building fabric and miscellaneous soft waste, i.e. rubber/PVC/paper. Most items size reduced in-situ. Some large items may be present.

Physical components (%vol): Gloveboxes (41%), pipework, valves and fittings (7%), plant and equipment (36%), ducting (6%), soft waste (10%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.35

Comment on density: Density stated is average for PCM.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless steel (59%), mild steel (29%), copper (0.5%), lead (trace), aluminium (0.5%), zinc (<0.05%), plastic (7%), rubber (2.5%), glass (0.5%), cellulose (1%). Percentages are by volume.

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Chemical state: Neutral

Chemical form of radionuclides: -

Metals and alloys (%wt): Some sheet metal present (~30%), bulk metal (70%). Composition percentages are by volume.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	59.0	The most commonly used stainless steel is 304L.	
Other ferrous metals	29.0		
Iron			
Aluminium	0.50		
Beryllium			
Cobalt	0		
Copper	0.50		
Lead	TR		
Magnox/Magnesium	0		
Nickel	0		
Titanium			
Uranium			
Zinc	<0.05		
Zircaloy/Zirconium	0		
Other metals	0		

Organics (%wt): The waste contains PVC and other plastics, small amounts of rubber and cellulose. Percentages are by volume. PVC oversuits, Windscale suits, waste bags, rubber gloves.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	1.0		
Paper, cotton	TR		
Wood	~1.0		
Halogenated plastics	5.0		
Total non-halogenated plastics	2.0		
Condensation polymers	1.0		
Others	1.0		
Organic ion exchange materials	0		
Total rubber	2.5		
Halogenated rubber	P		
Non-halogenated rubber	P		
Hydrocarbons			
Oil or grease			
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen			
Others			
Other organics	0		

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Other materials (%wt): Percentages are by volume.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	TR		
Cementitious material.....	TR		
Sand.....	0		
Glass/Ceramics.....	0.50		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	TR	Asbestos cement cladding, sheets, ceiling tiles and roof cladding.	
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
Fluoride.....	0	
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: Asbestos cement cladding, sheets, ceiling tiles and roof cladding.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	

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Putrescible wastes.....	0
Non-putrescible wastes.....	0
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	NE
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / non hazardous pollutants: Lead and asbestos are present in trace quantities.

	(%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.....	0	

Potential for the waste to contain discrete items: Yes. Conditioned waste in sealed drums, medium sized identifiable plant and equipment.

PACKAGING AND CONDITIONING

Conditioning method: The waste is assumed to leave decommissioning in 200 litre mild steel drums. Where possible these drums will be supercompacted. Pucks generated and any non-compactable drums wil be loaded into 500 litre product drums.

Plant Name: Waste Treatment Complex (WTC) 2

Location: Sellafield.

Plant startup date: 2034

Total capacity (m^3/y incoming waste): -

Target start date for packaging this stream: 2029

Throughput for this stream (m^3/y incoming waste): -

Other information: WTC 1 due to operate until April 2028. WTC2 begins operations in 2034 - waste generated in the interim period is planned to be interim stored in 200 l drums.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum (basket for waste)	100.0	~0.239	~0.504	10438

Likely container type comment: Conditioning and packaging factors revised as currently 6 feed drums are compacted on average per product drum.

Range in container waste volume: Between 1 and 9 compacted 200l drums will be put into a 500l drum.

Other information on containers: -

Likely conditioning matrix: PFA/OPC

Other information: -

Conditioned density (t/m^3): 2.0

Conditioned density comment: The density of the conditioned product will range from 1.5 to 2.6 t/m^3 for drums.

Other information on conditioning: -

Opportunities for alternative disposal routing: Yes

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Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at a Geological Disposal Facility	Disposal at LLWR	~20.0	2029	Medium	There is potential for up to 20% of waste to be diverted to LLWR.

RADIOACTIVITY

Source:	The main sources of activity are plutonium isotopes.
Uncertainty:	Activity levels will depend on degree of decontamination achieved.
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:	-
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				8	Gd 153				
Be 10				8	Ho 163				
C 14				8	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36				8	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41				8	Pt 193				
Mn 53					Tl 204				
Mn 54				8	Pb 205				
Fe 55				8	Pb 210				8
Co 60				8	Bi 208				
Ni 59				8	Bi 210m				
Ni 63				8	Po 210				8
Zn 65				8	Ra 223				
Se 79				8	Ra 225				
Kr 81					Ra 226				8
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90				8	Th 227				
Zr 93				8	Th 228				
Nb 91					Th 229				8
Nb 92					Th 230				8
Nb 93m				8	Th 232				8
Nb 94				8	Th 234				
Mo 93				8	Pa 231				8
Tc 97					Pa 233				
Tc 99				8	U 232				
Ru 106				8	U 233				8
Pd 107				8	U 234			2.49E-08	B C 2
Ag 108m				8	U 235			5.40E-07	B C 2
Ag 110m					U 236			2.49E-08	B C 2
Cd 109					U 238			7.73E-07	B C 2
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m				8	Pu 238			1.32E-02	B C 2
Sn 123					Pu 239			1.65E-02	B C 2
Sn 126				8	Pu 240			2.28E-02	B C 2
Sb 125					Pu 241			4.81E-01	B C 2
Sb 126					Pu 242			1.55E-05	B C 2
Te 125m					Am 241			4.99E-02	B C 2
Te 127m					Am 242m				
I 129				8	Am 243				
Cs 134				8	Cm 242				
Cs 135				8	Cm 243				
Cs 137				8	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144				8	Cf 249				
Pm 145					Cf 250				
Pm 147				8	Cf 251				
Sm 147					Cf 252				
Sm 151				8	Other a				
Eu 152				8	Other b/g				
Eu 154				8	**Total a**	**0**		**1.02E-01**	**B C 2**
Eu 155				8	**Total b/g**	**0**		**4.81E-01**	**B C 2**

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