WASTE STREAM 2D118 Plutonium Plants Initial/Interim Decommissioning: Processing Plants

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 - 31.3.2034.....	0 m³
	1.4.2034 - 31.3.2045.....	~26.2 m³
	1.4.2045 - 31.3.2048.....	0 m³
	1.4.2048 - 31.3.2058.....	~23.8 m³
	1.4.2058 - 31.3.2059.....	~4.0 m³
	1.4.2059 - 31.3.2063.....	~6.6 m³
	1.4.2063 - 31.3.2066.....	~12.1 m³
	1.4.2066 - 31.3.2073.....	~19.1 m³
	1.4.2074 - 31.3.2095.....	0 m³
	1.4.2095 - 31.3.2096.....	~2.5 m³
	1.4.2096 - 31.3.2105.....	~23.8 m³
	1.4.2105 - 31.3.2120.....	0 m³
Total future arisings:		118.2 m³
Total waste volume:		118.2 m³

Comment on volumes: Arisings based on decommissioning programme. Waste within this waste stream is generated from a number of 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 Waste arises from the dismantling of plutonium processing plant.

PHYSICAL CHARACTERISTICS

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

Physical components (%vol): Vessel/Tanks 38%, Gloveboxes 5%, Pipework, valves/fittings 5%, Handling Plant/Equip. 38%, H&V Ducting 6%, H&V Plant 5%, Secondary Steelwork/Cell cladding 3%.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.5

Comment on density: Density stated is average for ILW and includes some voidage.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless Steel 62.4%, Carbon/mild steel 36%, Copper 0.5%, Aluminium 0.5%, Lead 0.1%, Zinc 0.05%, Plastics 0.25%, Rubber 0.2%. Percentages by weight.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Not present in significant quantities.
C-14: Not present in significant quantities.
Cl-36: Not present in significant quantities.
Se-79: Not present in significant quantities.
Tc-99: Not present in significant quantities.
I-129: Not present in significant quantities.
Ra: Not present in significant quantities.

Th: Not present in significant quantities.
U: Not present in significant quantities.
Np: Not present in significant quantities.

Metals and alloys (%wt): Some sheet metal present (~30%), bulk metal (70%).

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	62.4	The most commonly used stainless steel is 304L.	
Other ferrous metals	36.0		
Iron			
Aluminium	0.50		
Beryllium	0		
Cobalt	0		
Copper	0.50		
Lead	0.10		
Magnox/Magnesium	0		
Nickel	0		
Titanium			
Uranium	0		
Zinc	0.05		
Zircaloy/Zirconium	0		
Other metals	0		

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

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	0		
Paper, cotton	0		
Wood	0		
Halogenated plastics	0.25		
Total non-halogenated plastics	0		
Condensation polymers	0		
Others	0		
Organic ion exchange materials	0		
Total rubber	0.20		
Halogenated rubber			
Non-halogenated rubber			
Hydrocarbons			
Oil or grease			
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen			
Others			
Other organics	0		

Other materials (%wt): -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	TR		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....	TR		
Glass/Ceramics.....			
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	TR	Due to the age of facilites covered by this waste stream trace amounts of white, blue and brown asbestos may be present.	
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): Inorganic anions are not expected to be present.

	(%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: -

	(%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	

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 is present. Asbestos.

	(%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. Toolls are likely to be present in this waste stream and steel fabrications may be present.

PACKAGING AND CONDITIONING

Conditioning method: The waste will be subject to in-situ size reduction prior to placing in a 3 m³ Decommissioning Concrete Container (DCC). No further size reduction or compaction will be carried out. Waste may be flood grouted if required for disposal.

Plant Name: Low End Encapsualtion capability and future replacement facilities.

Location: Sellafield.

Plant startup date: 2027

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: 2034

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

Other information: LEEC treatment capability and capacity are currently under develoment.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
Other(DCC)	~100.0	~0.51	~2.1	232

Likely container type comment: DCC - external envelope of a Sellafield 3 m³ box however it is made of fibre-reinforced concrete.

Range in container waste volume: The volume of raw waste in a container can vary from 5% to 65% by volume (Note a full container of dry sharp sand would be 50% by volume).

Other information on containers: Fibre reinforced concrete for DCC.

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m³): ~1.0

Conditioned density comment: Conditioned waste density varies depending on waste loading.

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	2025	Medium	There is potential for up to 20% of the waste to be diverted to LLWR. Note this waste would be consigned under 2D111.

RADIOACTIVITY

Source:	The main sources of activity are actinides and fission products.
Uncertainty:	Waste within this waste stream is generated from a number of decommissioning projects which will commence at a future date. The uncertainties quoted for each nuclide represent both the uncertainty in quantification without detailed sampling and the likely variation of nuclide in different building consigned wastes under this waste stream. It is exceptionally unlikely that all the waste included in this waste stream will have the same variation in nuclide fingerprint. Also 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:	Other alpha and other beta/gamma not specified.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³				
	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				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					8
Ag 108m				8	U 235					8
Ag 110m					U 236					8
Cd 109					U 238					8
Cd 113m					Np 237					8
Sn 119m					Pu 236					
Sn 121m				8	Pu 238			5.25E-03	C C	2
Sn 123					Pu 239			1.20E-02	C C	2
Sn 126				8	Pu 240			1.20E-02	C C	2
Sb 125					Pu 241			5.51E-01	C C	2
Sb 126					Pu 242			6.35E-06	C C	2
Te 125m					Am 241			1.35E-02	C C	2
Te 127m					Am 242m					8
I 129				8	Am 243					8
Cs 134				8	Cm 242					8
Cs 135				8	Cm 243					8
Cs 137				8	Cm 244					8
Ba 133					Cm 245					8
La 137					Cm 246					8
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					8
Eu 152				8	Other b/g					8
Eu 154				8	**Total a**		**0**	**4.27E-02**	**C C**	**2**
Eu 155				8	**Total b/g**		**0**	**5.51E-01**	**C B**	**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