WASTE STREAM 2D21 Solid Waste Storage Cells

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.....	440.0 m³
Total future arisings:		0 m³
Total waste volume:		440.0 m³

Comment on volumes: There will be no future arisings to this stream. It is believed that a more or less complete inventory is available for Cell 8 from tipping records; this gives a total volume of 55m³. This has been assumed to be the volume of waste in every cell, hence total waste = 8 x 55 = 440m³. All of this volume is conservatively assumed to be ILW.

Uncertainty factors on volumes:

Stock (upper):	x 1.25	Arisings (upper)	x
Stock (lower):	x 0.5	Arisings (lower)	x

WASTE SOURCE In cell stored waste was general operational waste associated with disposal of contaminated plant items and secondary wastes. Also, HEPA filters from ventilation systems, stored in mild steel boxes.

PHYSICAL CHARACTERISTICS

General description: Miscellaneous (beta/gamma active) solid waste (redundant pipework, plant equipment, HEPA filters, etc). The waste includes a mast 28 ft long, a cast iron flask (approx 42 t) and two concrete blocks (6 t each). Free liquor has been identified in one of the cells however this is due to be removed prior to waste export. Cells were originally open to the weather and so the cell wastes have deteriorated due to the damp conditions that occurred.

Physical components (%vol): Redundant pipework, plant equipment, HEPA filters in mild steel boxes, concrete/rubble. Metals (iron, steel, lead) 75%, organics (paper, wood, PVC, soil) 10%, concrete 10%, glass fibre <5%.

Sealed sources: -

Bulk density (t/m³): *2.5

Comment on density: * The density has been estimated from typical values for broken ferrous scrap. The average density of HEPA filters is 0.2 t/m³ as stored.

CHEMICAL COMPOSITION

General description and components (%wt): Metals (iron, steel, lead) >75%, organics (paper, wood, PVC, soil) <10%, concrete <10%, glass fibre <5%.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: NE
C-14: NE
Cl-36: NE
Se-79: NE
Tc-99: NE
I-129: NE
Ra: NE
Th: NE
U: NE
Np: NE
Pu: NE

Metals and alloys (%wt): Both sheet and bulk metal likely to be present, proportions not estimated.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	P	The split of material between stainless steel and other ferrous materials is unknown	
Other ferrous metals	P		
Iron	P		
Aluminium	NE		
Beryllium	NE		
Cobalt	NE		
Copper	NE		
Lead	P		
Magnox/Magnesium	NE		
Nickel	NE		
Titanium			
Uranium	NE		
Zinc	NE		
Zircaloy/Zirconium	NE		
Other metals	NE		

Organics (%wt): The average organic content of stocks and arisings is 4.5 wt%. Cellulosics, halogenated and non-halogenated plastics are present. Additionally soil and bird carcasses may be present. Halogenated plastic and rubber may be present, materials not specified due to the uncertainty of the waste in the concrete cells. PVC is known to be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	<2.0		
Paper, cotton			
Wood			
Halogenated plastics	~1.5		
Total non-halogenated plastics	~0.50		
Condensation polymers	~0.25		
Others	~0.25		
Organic ion exchange materials	0		
Total rubber	~0.50		
Halogenated rubber	<0.25		
Non-halogenated rubber	~0.25		
Hydrocarbons			
Oil or grease			
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen			
Others			
Other organics	<1.0		

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.....	0		
Soil.....	P		
Brick/Stone/Rubble.....	P		
Cementitious material.....	<5.0		
Sand.....			
Glass/Ceramics.....	<1.0		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	P		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	NE		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): Chlorides may be present as a result of the historic storage conditions.

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

Materials of interest for waste acceptance criteria: Some hazardous materials may be present. Remote video survey of Cell 1 has indicated presence of pipework cladding which is suspected to be some type of asbestos. It is not possible at the current time to sample this material to confirm this or estimate quantities. The presence of hazardous materials cannot be excluded.

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

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

Hazardous substances / non hazardous pollutants: Waste includes lead and asbestos.

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

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. Steel fabrications, a redundant flask and retrieval tools are likely to be included in this waste stream.

PACKAGING AND CONDITIONING

Conditioning method: It is proposed to retrieve the waste and place it into liners which will be placed into a DCC when DEP is available to take the waste. The Waste may be size-reduced or low-force compacted to improve the packing efficiency. At DEP, the DCC will be flood grouted and the grouted boxes will be placed into the Lightly Shielded Stores. Some boxes may contain waste not suitable for direct encapsulation or storage in a geological repository; the processing route for these is not yet defined.

Plant Name: DEP

Location: Sellafield.

Plant startup date: DEP 2027

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

Target start date for packaging this stream: -

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

Other information: Packaging capacity requirements depend upon the final amount of cell waste which is ILW. It is assumed that 75% of the cell waste is ILW but this figure could be as low as 25%.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
Other	~100.0	~2.1	~2.1	210

Likely container type comment: -

Range in container waste volume: There is likely to be a range of unconditioned waste per container due to the diverse nature of the cell inventory.

Other information on containers: Steel 3m^3 box - specification is still being quantified (may be DCC)

Likely conditioning matrix:

Other information: Cementitious grout, matrix not yet defined.

Conditioned density (t/m^3): ~1.3

Conditioned density comment: This conditioned waste density is calculated from the conditioned waste volume and mass of the waste.

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	NE	-	Medium	Some of this waste may be suitable for LLWR but quantities cannot yet be specified.

RADIOACTIVITY

Source:	The activity arises from activated steel or from fixed beta/gamma or alpha emitting contaminants (miscellaneous).
Uncertainty:	The specific activities have been derived by calculation. A number of assumptions have been made in the calculation and additional uncertainties introduced due to the following: The four main plants have between them consigned approximately 84% of the recorded inventory. The highest recorded dose rates are up to 1 order of magnitude greater than the average dose rate and upto 2 orders of magnitude greater than the lowest dose rates. Waste consignments started in the early 1970s and hence some waste will have had over 40 years decay. The known inventory records cover approximately 60% of the total assumed inventory.
Definition of total alpha and total beta/gamma:	No allowance has been included in the total alpha and total beta/gamma activities for nuclides other than those listed. No data is available to allow ‘other’ nuclides to be estimated.
Measurement of radioactivities:	Fingerprints for wastes from the four main consignors have been determined. These have been used in conjunction with dose rates at time of tipping, assumed to be 1986, and decayed to 2019, to calculate the specific activities in average case packages for each main consignor, then averaging these in line with the volume percent of waste consigned from each plant.
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	1.09E-05	C D 2			Gd 153				
Be 10					Ho 163				
C 14	1.90E-07	C D 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				
Co 60	5.71E-05	C D 2			Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227	3.29E-12	C D 2		
Sr 90	2.22E-02	C D 2			Th 227	3.23E-12	C D 2		
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230	1.44E-10	C D 2		
Nb 93m					Th 232				
Nb 94					Th 234	5.00E-07	C D 2		
Mo 93					Pa 231	8.20E-12	C D 2		
Tc 97					Pa 233	2.10E-05	C D 2		
Tc 99	1.70E-04	C D 2			U 232				
Ru 106	1.10E-12	C D 2			U 233	5.49E-10	C D 2		
Pd 107					U 234	4.60E-07	C D 2		
Ag 108m					U 235	1.10E-08	C D 2		
Ag 110m					U 236	5.40E-08	C D 2		
Cd 109					U 238	5.00E-07	C D 2		
Cd 113m					Np 237	2.10E-05	C D 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238	5.55E-04	C D 2		
Sn 123					Pu 239	2.00E-03	C D 2		
Sn 126	2.57E-08	C D 2			Pu 240	1.90E-03	C D 2		
Sb 125	2.63E-07	C D 2			Pu 241	4.08E-03	C D 2		
Sb 126					Pu 242	1.70E-06	C D 2		
Te 125m	6.59E-08	C D 2			Am 241	1.45E-03	C D 2		
Te 127m					Am 242m				
I 129	3.30E-04	C D 2			Am 243				
Cs 134	6.87E-08	C D 2			Cm 242	2.29E-19	C D 2		
Cs 135					Cm 243	5.67E-08	C D 2		
Cs 137	4.09E-02	C D 2			Cm 244	1.10E-06	C D 2		
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	8.15E-16	C D 2			Cf 249				
Pm 145					Cf 250				
Pm 147	2.24E-06	C D 2			Cf 251				
Sm 147					Cf 252				
Sm 151	1.74E-05	C D 2			Other a				
Eu 152	7.09E-07	C D 2			Other b/g				
Eu 154	9.37E-05	C D 2			**Total a**	**5.93E-03**	**C D 2**	**0**	
Eu 155	1.03E-05	C D 2			**Total b/g**	**6.79E-02**	**C D 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