

WASTE STREAM

2D21

Solid Waste Storage Cells

Stainless steel.....	P
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

The split of material between stainless steel and other ferrous materials is unknown

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.

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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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.

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.

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
 Non-putrescible wastes..... NE
 Corrosive materials..... 0
 Pyrophoric materials..... 0
 Generating toxic gases..... NE
 Reacting with water..... 0

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	Active particles.....	NE
	Soluble solids as bulk chemical compounds.....	NE
Hazardous substances / non hazardous pollutants:	Waste includes lead and asbestos.	
	Acrylamide.....	
	Benzene.....	NE
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	NE
	Styrene.....	
	Tri-butyl phosphate.....	NE
	Other organophosphates.....	
	Vinyl chloride.....	NE
	Arsenic.....	NE
	Barium.....	
	Boron.....	NE
	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	
	EDTA.....	
	DPTA.....	
	NTA.....	
	Polycarboxylic acids.....	
	Other organic complexants.....	
	Total complexing agents.....	0

PACKAGING AND CONDITIONING

Conditioning method: It is proposed to retrieve the waste and place it into liners which will be placed into 3m³ boxes when BEP is available to take the waste. The Waste may be size-reduced or low-force compacted to improve the packing efficiency. At BEP, the 3m³ boxes will be filled with grout and the grouted boxes will be placed into the BEP Product Store. 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: Box Encapsulation Plant.

Location: Sellafield.

Plant startup date: BEP Flood Grout commences December 2022 (GEN-5601A).

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m³/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
	Sellafield 3m ³ box	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 3m³ box - specification is still being quantified.

Likely conditioning matrix:

Other information: Cementitious grout, matrix not yet defined.

Conditioned density (t/m³): ~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:

Treatment	Stream volume (%)	Comment
-	-	-

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:

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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/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	1.29E-05	CD 2			Gd 153				
Be 10					Ho 163				
C 14	1.90E-07	CD 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	8.48E-05	CD 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	2.83E-12	CD 2		
Sr 90	2.38E-02	CD 2			Th 227	2.78E-12	CD 2		
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230	1.31E-10	CD 2		
Nb 93m					Th 232				
Nb 94					Th 234	5.00E-07	CD 2		
Mo 93					Pa 231	7.50E-12	CD 2		
Tc 97					Pa 233	2.10E-05	CD 2		
Tc 99	1.70E-04	CD 2			U 232				
Ru 106	8.61E-12	CD 2			U 233	2.74E-10	CD 2		
Pd 107					U 234	4.55E-07	CD 2		
Ag 108m					U 235	1.10E-08	CD 2		
Ag 110m					U 236	5.39E-08	CD 2		
Cd 109					U 238	5.00E-07	CD 2		
Cd 113m					Np 237	2.10E-05	CD 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238	5.68E-04	CD 2		
Sn 123					Pu 239	2.00E-03	CD 2		
Sn 126	2.57E-08	CD 2			Pu 240	1.90E-03	CD 2		
Sb 125	5.59E-07	CD 2			Pu 241	4.71E-03	CD 2		
Sb 126					Pu 242	1.70E-06	CD 2		
Te 125m	1.40E-07	CD 2			Am 241	1.44E-03	CD 2		
Te 127m					Am 242m				
I 129	3.30E-04	CD 2			Am 243				
Cs 134	1.88E-07	CD 2			Cm 242	2.42E-17	CD 2		
Cs 135					Cm 243	6.08E-08	CD 2		
Cs 137	4.38E-02	CD 2			Cm 244	1.24E-06	CD 2		
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	1.17E-14	CD 2			Cf 249				
Pm 145					Cf 250				
Pm 147	4.95E-06	CD 2			Cf 251				
Sm 147					Cf 252				
Sm 151	1.78E-05	CD 2			Other a				
Eu 152	8.27E-07	CD 2			Other b/g				
Eu 154	1.19E-04	CD 2			Total a	5.93E-03	CD 2	0	
Eu 155	1.58E-05	CD 2			Total b/g	7.31E-02	CD 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