



**WASTE STREAM**

**2D06**

**Plutonium Contaminated Materials; Crates and Filters**

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	<50.2		
Other ferrous metals.....	<15.0		
Iron.....	<0.10		
Aluminium.....	<1.5		
Beryllium.....			
Cobalt.....	0		
Copper.....	<1.0		
Lead.....	<1.0		
Magnox/Magnesium.....	TR		
Nickel.....			
Titanium.....	<0.50		
Uranium.....			
Zinc.....	<0.10		
Zircaloy/Zirconium.....	0		
Other metals.....	0		

**Organics (%wt):**

The waste contains cellulosic materials, halogenated and non-halogenated plastics and rubber. The crates are constructed of wood, driclad (a form of PVC) and fibreglass. Total organic content is a preliminary estimate only. Driclad (PVC).

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	<8.6		
Paper, cotton.....	NE		
Wood.....	<8.6		
Halogenated plastics .....	<8.6		
Total non-halogenated plastics.....	<8.6		
Condensation polymers.....	0		
Others.....	<8.6		
Organic ion exchange materials....	0		
Total rubber.....	<3.2		
Halogenated rubber .....	<1.6		
Non-halogenated rubber.....	<1.6		
Hydrocarbons.....	0		
Oil or grease .....	0		
Fuel.....	0		
Asphalt/Tarmac (cont.coal tar)...	0		
Asphalt/Tarmac (no coal tar)....	0		
Bitumen.....	P		
Others.....	0		
Other organics.....	TR		

**Other materials (%wt):**

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	P		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	<0.50		
Sand.....			
Glass/Ceramics.....	P		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	<0.10		
Non/low friable.....	NE		
Moderately friable.....	NE		
Highly friable.....	NE		
Free aqueous liquids.....	<1.0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): Fluoride, if present, will be as PuF4. Others are unlikely to be present.

	(%wt)	Type(s) and comment
Fluoride.....	TR	
Chloride.....	TR	
Iodide.....	TR	
Cyanide.....	0	
Carbonate.....	TR	
Nitrate.....	TR	
Nitrite.....	NE	
Phosphate.....	TR	
Sulphate.....	TR	
Sulphide.....	TR	

Materials of interest for waste acceptance criteria: Some crates may contain hazardous materials in small quantities (<1%).

	(%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.....	NE	
Putrescible wastes.....	NE	
Non-putrescible wastes.....	NE	

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

Hazardous substances / Toxic metals present in trace quantities only.  
non hazardous pollutants:

	(%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.....	0	
Barium.....	NE	
Boron.....	NE	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	<0.10	
Caesium.....	NE	
Selenium.....	NE	
Chromium.....	NE	
Molybdenum.....	NE	
Thallium.....	NE	
Tin.....	<0.10	
Vanadium.....	NE	
Mercury compounds.....	NE	
Others.....	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	0	
EEE Type 2.....	<0.50	
EEE Type 3.....	0	
EEE Type 4.....	0	
EEE Type 5.....	0	

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....	0	
Other organic complexants.....	TR	Trace amounts of organic complexing agents may be present.
Total complexing agents.....	TR	

Potential for the waste to contain discrete items: Yes. Crates have the possibility to contain discrete items however larger items are likely to be broken down into 200L drums and then compacted.

**PACKAGING AND CONDITIONING**

Conditioning method: To be compatible with the current conditioning process for PCM items in the 2D06 waste stream would need to be size reduced and loaded into 200 litre drums. These 200 litre drums could then be supercompacted in the Waste Treatment Complex (WTC) and loaded into a basket within a 500 l drum such that there is a cement annulus between the basket and the drum skin. There are currently no operational facilities for the size reduction of crates and filter stillages in to 200 litre drums. Future Waste Treatment Complex (WTC) facilities are currently projected to use a similar treatment method.

Plant Name: Waste Treatment Complex (future capabilities are anticipated to be titled WTC2 & WTC3).

Location: Sellafield.

Plant startup date: 1997 (It is anticipated that WTC2 will become operational in ~2034 and WTC3 in ~2061).

Total capacity (m<sup>3</sup>/y incoming waste): NE

Target start date for packaging this stream: -

Throughput for this stream (m<sup>3</sup>/y incoming waste): NE

Other information: Backlog and fresh arisings will be conditioned concurrently.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	500 l drum (basket for waste)	100.0	~0.844	~0.504	6646

Likely container type comment: -

Range in container waste volume: Typically between 1 and 10 compacted 200 litre drums will be loaded into a 500 litre drum, with an average of 5.6. It is expected that 10% of crated waste (7.11% of total waste volume) won't be compactable so will be directly grouted. The range and variability for WTC2 & WTC3 have yet to be assessed, although it is assumed that the values will be similar to those for the current WTC facility.

Other information on containers: Stainless Steel

Likely conditioning matrix: Other

Other information: GGBS/CEM I

Conditioned density (t/m<sup>3</sup>): 2.1

Conditioned density comment: Conditioned density calculated using data from current WTC product drum stock. The density is typically between 1.8 and 2.6 t/m<sup>3</sup>, although values outside of this range are

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possible.  
Other information on conditioning: -

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 a Geological Disposal Facility	Disposal at LLWR	~1.0	2023	Medium	26 crates to be processed by active demonstrator project. Will be consigned under 2X89 waste stream.
Disposal at a Geological Disposal Facility	Disposal at LLWR	~20.0	2025	Medium	3,500 filters are projected to be below LLW limits once subject to assay. Will be consigned under 2X41 waste stream.
Disposal at a Geological Disposal Facility	Disposal at LLWR	~31.0	2030	Low	Following the active demonstration work it is estimated that 50% of the remaining crate population may fall within the LLW limits. Identification and segregation of these crates will be informed by the demonstration work and as such this opportunity is currently very immature.

**RADIOACTIVITY**

Source: The principal nuclides are Pu-238, Pu-239, Pu-240, Pu241, Pu 242 and Am241.

Uncertainty: The activity accuracy is based on records of arisings.

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: The specific activities were calculated using an average fingerprint for the stream (determined through measurements of several thousand drums of similar provenance through the WTC and EDS assay suites) and the total Pu mass of the current stocks.

Other information: -

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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					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					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210				
Co 60					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				
Sr 90					Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232	5.44E-08	BB 2		
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235	1.21E-07	BB 2		
Ag 110m					U 236				
Cd 109					U 238	4.55E-07	BB 2	3.01E-08	CC 2
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238	4.82E-03	BB 2	8.75E-03	CC 2
Sn 123					Pu 239	2.31E-02	BB 2	2.03E-02	CC 2
Sn 126					Pu 240	1.11E-02	BB 2	1.67E-02	CC 2
Sb 125					Pu 241	2.48E-01	BB 2	4.95E-01	CC 2
Sb 126					Pu 242	5.52E-06	BB 2	1.04E-05	CC 2
Te 125m					Am 241	9.40E-03	BB 2	8.30E-03	CC 2
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137					Cm 244				
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					<b>Total a</b>	<b>4.84E-02</b>	<b>BB 2</b>	<b>5.41E-02</b>	<b>CC 2</b>
Eu 155					<b>Total b/g</b>	<b>2.48E-01</b>	<b>BB 2</b>	<b>4.95E-01</b>	<b>CC 2</b>

**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