WASTE STREAM 2D83/C Encapsulated Plutonium Contaminated Materials

SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	3321.5 m³	3763.0 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		3321.5 m³	3763.0 m³
Number of waste packages in stock:	At 1.4.2019.....	6643 package(s)	

Comment on volumes: The stock level provided reflects the current volume held at Sellafield in designated PCM stores, these items are tracked and hence known to a good level of accuracy. Current stock includes the products containing waste processed from 2D03, 2D06, 2F02, 2F34 and 2D90 waste streams. Future arisings have been excluded to prevent double counting with the raw PCM streams.

Uncertainty factors on volumes:

Stock (upper):	x 1.0	Arisings (upper)	x
Stock (lower):	x 1.0	Arisings (lower)	x

WASTE SOURCE PCM has arisen principally from Sellafield operations.

PHYSICAL CHARACTERISTICS

General description: The waste consists of supercompacted pucks of PCM, grouted in a cement matrix. PCM consists of solid materials such as PVC gloves, filters, paper towels, small plant items and tools, bagged or wrapped in PVC and placed in 200 litre mild steel drums. These drums are supercompacted into pucks and placed in 500 litre drums. No items require special handling. 200 litre drums of PCM are supercompacted in the Waste Treatment Complex. The compacts are loaded into a basket within a 500 litre drum and the remaining space is filled with an OPC/PFA grout.

Physical components (%wt): PVC gloves, filters, paper towels and small plant items. All items are double bagged in PVC and heat sealed. Small plant items include hand tools, laboratory equipment (especially glassware) and packaging cans. Material breakdown: PVC (5%), Rubber (3%), Metal (32%), Cellulose (1%), Cement (57%), Other (2%). Note that this includes the sacrifical mild steel drums, the cement encapsulating matrix and the stainless steel product container.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 2.1

Comment on density: Range of densities is approximately 1.8 to 2.6 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): The waste has a mixed chemical composition: PVC (5%), Rubber (3%), Metal (32%), Cellulose (1%), Cement (57%), Other (2%).

Chemical state: Alkali

Chemical form of radionuclides: U: Metals, oxides, nitrates.
Pu: Metals, oxides, nitrates, fluorides, oxalates.

Metals and alloys (%wt): Mostly sheet metal, from the 200 litre drums. Some bulk metal also present.

Stainless steel.....	15.5	
Other ferrous metals.....	15.7	
Iron.....	0	
Aluminium.....	0.30	
Beryllium.....	0	
Cobalt.....	TR	May be present in alloy hand tools.

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	Copper	P	
	Lead	P	
	Magnox/Magnesium	0	
	Nickel	TR	May be present in alloy hand tools.
	Titanium	TR	May be present in alloy hand tools.
	Uranium	0	
	Zinc	P	
	Zircaloy/Zirconium	TR	
	Other metals	P	Very small quantities of gold may be present in this waste stream.
Organics (%wt):	The majority of the organic material in the waste is PVC with small quantities of rubber, cellulose, polythene and perspex. The total organics content is about 11%.		
	Total cellulosics	1.4	
	Paper, cotton	1.3	
	Wood	0.10	
	Halogenated plastics	5.2	Typically PVC.
	Total non-halogenated plastics	1.4	Includes nylon, perspex and polythene.
	Condensation polymers	0	
	Others	~1.4	
	Organic ion exchange materials	TR	
	Total rubber	3.2	
	Halogenated rubber	3.2	
	Non-halogenated rubber	0	
	Hydrocarbons	0.10	
	Oil or grease	TR	
	Fuel	0	
	Asphalt/Tarmac (cont.coal tar)	0.10	
	Asphalt/Tarmac (no coal tar)	0	
	Bitumen	TR	
	Others	0	
	Other organics	0	
Other materials (%wt):	-		
	Inorganic ion exchange materials.	TR	
	Inorganic sludges and flocs	0	
	Soil	P	
	Brick/Stone/Rubble	0.10	
	Cementitious material	~56.7	
	Sand	0	
	Glass/Ceramics	0.40	
	Graphite	0	
	Desiccants/Catalysts	0	
	Asbestos	P	

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Non/low friable	NE	
Moderately friable	NE	
Highly friable	NE	
Free aqueous liquids	P	
Free non-aqueous liquids	0	
Powder/Ash	0	

Inorganic anions (%wt): Most of the listed anions may be present in trace quantities (<0.1%).

Fluoride	<0.40	Fluorides of Calcium, Sodium and Potassium may be present in small quantities.
Chloride	<0.10	
Iodide	<0.10	
Cyanide	0	
Carbonate	<0.10	
Nitrate	<0.10	
Nitrite	NE	
Phosphate	<0.10	
Sulphate	<0.10	
Sulphide	<0.10	

Materials of interest for waste acceptance criteria: The waste will include chemical contaminants, traces of acids and alkalis, and small amounts of asbestos.

Combustible metals	0
Low flash point liquids	0
Explosive materials	0
Phosphorus	0
Hydrides	0
Biological etc. materials	0
Biodegradable materials	NE
Putrescible wastes	0
Non-putrescible wastes	NE
Corrosive materials	0
Pyrophoric materials	0
Generating toxic gases	0
Reacting with water	0
Active particles	0
Soluble solids as bulk chemical compounds	0

Hazardous substances / non hazardous pollutants: The waste stream specifically excludes toxic materials and therefore they are present in trace quantities only. Asbestos (<0.4%), laboratory chemicals (<0.4%).

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	NE	
	Barium	NE	
	Boron	NE	
	Cadmium	TR	
	Caesium	NE	
	Selenium	NE	
	Chromium	TR	May be present in alloy hand tools.
	Molybdenum	NE	
	Thallium	NE	
	Tin	NE	
	Vanadium	TR	May be present in alloy hand tools.
	Mercury compounds	TR	
	Others	NE	
	Electronic Electrical Equipment (EEE)		
	EEE Type 1	NE	
	EEE Type 2	NE	
	EEE Type 3	P	
	EEE Type 4	NE	
	EEE Type 5	NE	
Complexing agents (%wt):	Yes		
	EDTA		
	DPTA		
	NTA		
	Polycarboxylic acids	0	
	Other organic complexants	TR	Trace amounts of organic complexing agents may be present.
	Total complexing agents	TR	

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum (basket for waste)	100.0	0.504	0.504	6591

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Container type comment:	-
Range in container waste volume:	-
Other information on containers:	Stainless steel
Conditioned density (t/m³):	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/m³, although values outside of this range are possible.
Other information on conditioning:	WTC phase 1 (supercompaction) began treating stored PCM and current arisings in 1997 and will continue to 2034. A new facility is currently scheduled to condition the raw waste from 2034, with a further replacement scheduled for 2061.

RADIOACTIVITY

Source:	The principal nuclides are Pu-238, Pu-239, Pu-240, Pu-241 and Am-241.
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 through the WTC and EDS assay suites) and the total Pu mass of the current stocks.
Other information:	The 500 l product drums will be loaded to a maximum of 260 g Pu + U235.

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	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				
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				
Ag 110m					U 236				
Cd 109					U 238	2.63E-06	B B 2		
Cd 113m					Np 237	1.64E-05	B B 2		
Sn 119m					Pu 236				
Sn 121m					Pu 238	1.75E-01	B B 2		
Sn 123					Pu 239	1.52E-01	B B 2		
Sn 126					Pu 240	1.50E-01	B B 2		
Sb 125					Pu 241	4.96E+00	B B 2		
Sb 126					Pu 242	1.32E-04	B B 2		
Te 125m					Am 241	8.21E-02	B B 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					**Total a**	**5.59E-01**	**B B 2**	**0**	
Eu 155					**Total b/g**	**4.96E+00**	**B B 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