WASTE STREAM 2D06 Plutonium Contaminated Materials; Crates and Filters

SITE	Sellafield
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Sellafield Limited
WASTE TYPE	ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	4958.2 m³
Future arisings -	1.4.2019 - 31.3.2020.....	63.4 m³
	1.4.2020 - 31.3.2021.....	47.6 m³
	1.4.2021 - 31.3.2022.....	20.6 m³
	1.4.2022 - 31.3.2023.....	17.6 m³
	1.4.2023 - 31.3.2024.....	17.6 m³
	1.4.2024 - 31.3.2025.....	20.6 m³
	1.4.2025 - 31.3.2047.....	388.1 m³
Total future arisings:		575.4 m³
Total waste volume:		5533.6 m³

Comment on volumes: Crates arise from plant refurbishment activities and decommissioning when there is an overriding need to move a large PCM item undismantled in order to progress a priority project. This is often an irregular and infrequent occurrence. Filters arise on a continual basis from older facilities as part of plant operations and POCO/decommissioning activities. 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. Future arisings based on consignor estimates, experience of receipts indicates that there is a 50% uncertainty associated with these predictions.

Uncertainty factors on volumes:

Stock (upper):	x 1.05	Arisings (upper)	x 1.5
Stock (lower):	x 0.95	Arisings (lower)	x 0.5

WASTE SOURCE PCM has arisen principally from Sellafield operations. Some crated waste transferred from the LLWR is known to originate from other UK nuclear facilities.

PHYSICAL CHARACTERISTICS

General description: Contents of crates are predominantly glove boxes, with or without the equipment they contain (e.g. furnaces, ducting, presses etc). Crates are made of timber, S/S or fibreglass and some are covered in driclad (a type of PVC) on steel supports. Most crates (say 60%) are less than 2m x 2m x 2m, although the largest is in the region of 4m x 3m x 6m. Components will not fit into 200 litre drums. It is estimated that crates may weigh up to 10,000 kg. Filters are made of mild steel frame with glass fibre insert and aluminium spacers. The filters are double wrapped in PVC and stored in a stillage. Generally each filter is also housed within an individual stainless steel metal case.

Physical components (%wt): The content of the waste stream is predominantly metal (~70%), plastic (~18%) wood (~9%), rubber (~3%). This composition includes all crate and filter box materials.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~~0.2

Comment on density: The density has been estimated from the available weights and dimensions of crates and filter stillages.

CHEMICAL COMPOSITION

General description and components (%wt): The waste stream comprises metal (~70%), plastic (~18%) wood (~9%), rubber (~3%). This composition includes all crate and filter box materials.

Chemical state: Neutral

Chemical form of radionuclides: U: Present as metal, oxide and nitrate.
Pu: Present as metal, oxide, fluoride and nitrate.

Metals and alloys (%wt): Both sheet and bulk metals are likely to be present. Proportions not estimated.

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	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).	
	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):	-	
	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.

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%).

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

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

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
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

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	

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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 anticpated 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^3/y incoming waste):	NE
Target start date for packaging this stream:	-
Throughput for this stream (m^3/y incoming waste):	NE
Other information:	Backlog and fresh arisings will be conditioned concurrently.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum (basket for waste)	100.0	~1.12	~0.504	4941

Likely container type comment:	-
Range in container waste volume:	Typically between 1 and 10 compacted 200 litre drums will be loaded in to a 500 litre drum, with an average of 5.6. 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:	Pulverised fuel ash/Ordinary Portland cement mixture
Other information:	A PFA/OPC grout mix is used to generate the grout annulus which surrounds the compacted feed drums in a WTC product drum. The conditioning matrix relevant to future facilities (WTC2 and WTC3) is currently unknown.
Conditioned density (t/m^3):	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^3, although values outside of this range are possible.
Other information on conditioning:	-
Opportunities for alternative disposal routing:	Not yet determined

Treatment	Stream volume (%)	Comment
-	-	-

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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/m³				Nuclide	Mean radioactivity, TBq/m³			
	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					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	1.04E-07	B B 2		
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232	1.14E-07	B B 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	2.77E-07	B B 2		
Ag 110m					U 236				
Cd 109					U 238	9.48E-07	B B 2		
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238	4.35E-03	B B 2	9.63E-03	C C 2
Sn 123					Pu 239	2.29E-02	B B 2	2.21E-02	C C 2
Sn 126					Pu 240	1.04E-02	B B 2	1.82E-02	C C 2
Sb 125					Pu 241	2.25E-01	B B 2	5.59E-01	C C 2
Sb 126					Pu 242	5.07E-06	B B 2	1.14E-05	C C 2
Te 125m					Am 241	7.96E-03	B B 2	5.19E-03	C C 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**	**4.56E-02**	**B B 2**	**5.51E-02**	**C C 2**
Eu 155					**Total b/g**	**2.25E-01**	**B B 2**	**5.59E-01**	**C C 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