WASTE STREAM 2F02 Plutonium Contaminated Materials; Drums

SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	61.8 m³
Future arisings -	1.4.2019 - 31.3.2020.....	22.0 m³
	1.4.2020 - 31.3.2021.....	11.2 m³
	1.4.2021 - 31.3.2022.....	6.0 m³
	1.4.2022 - 31.3.2023.....	4.8 m³
	1.4.2023 - 31.3.2024.....	2.8 m³
	1.4.2024 - 31.3.2025.....	2.0 m³
	1.4.2025 - 31.3.2026.....	2.0 m³
	1.4.2026 - 31.3.2027.....	2.8 m³
	1.4.2027 - 31.3.2043.....	32.0 m³
Total future arisings:		85.6 m³
Total waste volume:		147.4 m³

Comment on volumes: Following completion of reprocessing operations in THORP the arisings profile will align with planned Post Operational Clean Out (POCO) and care and maintenance activities required prior to the decomissioning of the facility. 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. Arisings of PCM are not generally predictable. For this waste stream predicted volumes will be subject to refinement as the scope of POCO develops.

Uncertainty factors on volumes:

Stock (upper):	x 1.01	Arisings (upper)	x 1.5
Stock (lower):	x 0.99	Arisings (lower)	x 0.5

WASTE SOURCE PCM which will arise from the operation of the Thorp plant and subsequent POCO activities.

PHYSICAL CHARACTERISTICS

General description: Plutonium contaminated solid material which will arise from the operation of the Thorp plant including PVC gloves, filters, paper towels, process residues and plant items. No physical or chemical changes.

Physical components (%wt): PVC gloves, filters, paper towels, process residues, plant items and metal. Material breakdown: Metal (80%), PVC (13%), Cellulose (6%), Others (1%). The composostion includes the sacrificial 200 litre drum.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.3

Comment on density: The density will range from 0.2 t/m³ to approx. 0.5t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): PVC, cellulose, mild steel, stainless steel, other metals and alloys, polythene, aluminium, polypropylene and fibre glass. The relative percentages of each constituent will vary substantially from package to package. Overall material breakdown: Metal (80%), PVC (13%), Cellulose (6%), Others (1%). This composition includes the sacrificial 200 litre drum.

Chemical state: Neutral

Chemical form of radionuclides: U: Metal, oxide, nitrate.
Pu: Metal, oxide, nitrate, fluoride, oxalate.

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

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	Stainless steel	22.3	
	Other ferrous metals	45.7	
	Iron	0	
	Aluminium	<11.9	
	Beryllium	0	
	Cobalt	TR	Possibly included as part of hand tool alloy.
	Copper	0	
	Lead	0	
	Magnox/Magnesium	0	
	Nickel	TR	Possibly included as part of hand tool alloy.
	Titanium	TR	Possibly included as part of hand tool alloy.
	Uranium	0	
	Zinc	0	
	Zircaloy/Zirconium	TR	
	Other metals	0	
Organics (%wt):	The organics included in the waste are cellulosics and halogenated plastics. The total organics content is about 20%.		
	Total cellulosics	6.7	
	Paper, cotton	3.8	
	Wood	2.9	
	Halogenated plastics	12.8	PVC.
	Total non-halogenated plastics	0	
	Condensation polymers	0	
	Others	0	
	Organic ion exchange materials	0	
	Total rubber	0	
	Halogenated rubber	0	
	Non-halogenated rubber	0	
	Hydrocarbons	0	
	Oil or grease	0	
	Fuel	0	
	Asphalt/Tarmac (cont.coal tar)	0	
	Asphalt/Tarmac (no coal tar)	0	
	Bitumen	0	
	Others	0	
	Other organics	0	
Other materials (%wt):	-		

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Inorganic ion exchange materials.	0	
Inorganic sludges and flocs.....	0	
Soil.....	0	
Brick/Stone/Rubble.....	0	
Cementitious material.....	0	
Sand.....	0	
Glass/Ceramics.....	0.60	
Graphite.....	0	
Desiccants/Catalysts.....	0	
Asbestos.....	0	
Non/low friable.....	0	
Moderately friable.....	0	
Highly friable.....	0	
Free aqueous liquids.....	P	
Free non-aqueous liquids.....	0	
Powder/Ash.....	0	

Inorganic anions (%wt): Most inorganic anions may be present in trace quantities.

Fluoride.....	<0.10	
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: Chemical contaminants may be present.

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.....	TR	Very small traces of oxalic and nitric acids may be present.
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	

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Active particles	0	
Soluble solids as bulk chemical compounds	0	

Hazardous substances / non hazardous pollutants: Hazardous substances may be present in small or trace quantities.

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	NE	
Caesium	NE	
Selenium	NE	
Chromium	NE	
Molybdenum	NE	
Thallium	NE	
Tin	NE	
Vanadium	TR	Possibly included as part of hand tool alloy.
Mercury compounds	NE	
Others	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1	NE	
EEE Type 2	NE	
EEE Type 3	NE	
EEE Type 4	NE	
EEE Type 5	NE	

Complexing agents (%wt): Yes

EDTA		
DPTA		
NTA		
Polycarboxylic acids	0	
Other organic complexants	TR	Various decontamination chemicals may be present.
Total complexing agents	TR	

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PACKAGING AND CONDITIONING

Conditioning method:	The current conditioning method for 2F02 is processing through the Waste Treatment Complex (WTC) where 200 litre drum of waste are supercompacted and the pucks loaded into a basket within a 500 litre drum (such that there is a cement annulus between the basket and the drum skin). Replacement 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):	780.0
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. Stream throughput is variable and cannot be estimated, this is due to waste streams 2D03, 2D90, 2F02 and 2F34 being processed concurrently in WTC.

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	132

Likely container type comment:	-
Range in container waste volume:	The reported waste loading is for the current WTC (supercompaction) process. 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:	PFA/OPC
Other information:	-
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:	Yes

Treatment	Stream volume (%)	Comment
Disposal as low level waste (LLW)	~10.0	New assay capability will allow for the re-categorisation of some waste as LLW. It is anticipated that 800 drums a year (from streams 2D03, 2D90, 2F02 and 2F34 collectively) will be consigned as LLW between 2019 and 2024 inclusive. Thereafter it is prediced that 10% of the arisings from the four waste streams will be identified and treated as LLW. This waste will be processed under the 2X40 waste stream.

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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 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				
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	1.73E-07	B B 2	1.73E-07	C C 2
Cd 113m					Np 237	1.71E-06	B B 2	1.71E-06	C C 2
Sn 119m					Pu 236				
Sn 121m					Pu 238	9.12E-01	B B 2	9.12E-01	C C 2
Sn 123					Pu 239	1.64E-01	B B 2	1.64E-01	C C 2
Sn 126					Pu 240	2.79E-01	B B 2	2.79E-01	C C 2
Sb 125					Pu 241	1.59E+01	B B 2	1.59E+01	C C 2
Sb 126					Pu 242	4.47E-04	B B 2	4.47E-04	C C 2
Te 125m					Am 241	2.25E-01	B B 2	2.25E-01	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**	**1.58E+00**	**B B 2**	**1.58E+00**	**C C 2**
Eu 155					**Total b/g**	**1.59E+01**	**B B 2**	**1.59E+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