

WASTE STREAM	2F34	Plutonium Contaminated Materials; Drums
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SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Ltd

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025 = 15.2			
Future arisings:	1.4.2025 - 31.3.2026 = 5.0			
	1.4.2026 - 31.3.2027 = 5.0			
	1.4.2027 - 31.3.2028 = 4.0			
	1.4.2028 - 31.3.2029 = 3.2			
	1.4.2029 - 31.3.2030 = 2.8			
	1.4.2030 - 31.3.2031 = 2.2			
	1.4.2031 - 31.3.2032 = 2.2			
	1.4.2032 - 31.3.2033 = 2.2			
	1.4.2033 - 31.3.2034 = 2.2			
	1.4.2034 - 31.3.2035 = 2.2			
Total future arisings:	31.0			
Total waste volume:	46.2			

Number of waste packages in stock: At 1.4.2025..... - packages

Comment on arising rates: Arisings are based upon an element of routine arising and programmed events such as a refurbishment occurring in a particular year and sampling operations.

Additional information on quantities: 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. Prediction of future arisings are updated annually by consignors however experience of actual receipts has shown that these predictions typically have a high level of uncertainty associated with them.

Uncertainty factors on volumes: Stock (upper): x 1.10 Arisings (upper): x 1.50
Stock (lower): x 0.90 Arisings (lower): x 0.50

WASTE SOURCE PCM has arisen from the production of MOX fuel and from maintenance work and sampling operations. As the facility enters Post Operational Clean Out (POCO) waste will also arise from the associated activities.

PHYSICAL CHARACTERISTICS

General description: Plutonium contaminated solid material which has arisen from MOX fuel production, including PVC gloves, filters, paper towels, process residues and plant items. Waste has also arisen from POCO activities following the end of operations.

Changes since waste generated: No physical or chemical changes.

Bulk density (t/m³): ~ 0.30

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, rubber, aluminium, fibre glass and ceramics. The relative percentages of each constituent will vary substantially from package to package. Overall material breakdown: metal (60%), rubber (35%) and soft organics (5%). The composition includes the sacrificial 200 litre drum.

Chemical state: Neutral

Sheet metal proportion / thickness: Both sheet and bulk metal likely to be present, proportions not estimated.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 6.0	-	
Other ferrous metals.....	< 50.3	-	
Iron.....	-	-	
Aluminium.....	< 3.4	-	
Beryllium.....	= 0	-	
Cobalt.....	TR	Potentially associated with alloy hand tools.	
Copper.....	= 0	-	
Lead.....	P	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	TR	Potentially associated with alloy hand tools.	
Titanium.....	TR	Potentially associated with alloy hand tools.	
Uranium.....	= 0	-	
Zinc.....	P	-	
Zircaloy/Zirconium.....	P	-	
Other metals.....	TR 0	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	= 1.8	-	
Paper, cotton.....	= 1.8	-	
Wood.....	= 0	-	
Halogenated plastics.....	= 2.9	PVC.	
Total non-halogenated plastics.....	= 0.24	-	
Condensation polymers.....	= 0	-	
Others.....	= 0.24	Includes nylon	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	= 34.8	-	
Halogenated rubber.....	= 0	-	
Non-halogenated rubber.....	= 34.8	-	
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):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 0	-	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	TR	-	
Sand.....	= 0	-	
Glass/Ceramics.....	= 0.22	-	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	= 0	-	
Asbestos.....	P	-	
Non/low friable.....	-	-	
Moderately friable.....	-	-	
Highly friable.....	-	-	
Free aqueous liquids.....	= 0	-	
Free non-aqueous liquids.....	= 0	-	
Powder/Ash.....	= 0	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
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:

	(%wt)	Type(s) and comment
Combustible metals.....	= 0	-
Low flash point liquids.....	= 0	-
Explosive materials.....	= 0	-
Phosphorus.....	= 0	-
Hydrides.....	= 0	-
Biological etc. materials.....	= 0	-
Biodegradable materials.....	= 0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....	NE	-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	= 0	-
Higher activity particles.....	= 0	-
Soluble solids as bulk chemical compounds.....	= 0	-

Hazardous substances / 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.....	NE	-
Barium.....	NE	-
Boron.....	NE	-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	NE	-
Caesium.....	NE	-
Selenium.....	NE	-
Chromium.....	TR	Potentially associated with alloy hand tools.
Molybdenum.....	= 0.34	-
Thallium.....	NE	-
Tin.....	NE	-
Vanadium.....	TR	Potentially associated with alloy hand tools.
Mercury compounds.....	NE	-
Others.....	NE	-

Complexing agents (%wt):

Yes		
	(%wt)	Type(s) and comment
EDTA.....		-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....	= 0	-
Other organic complexants.....	TR	Various decontamination chemicals may be present.
Total complexing agents.....	TR	-

Physical components:

	Number	Type(s) and comment
Sources.....	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	-

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off-site	Stream volume %
Size reduction	On-site	> 97.7
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application	On-site	< 2.3
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		

Comments on planned treatments:

1

Conditioning method:

The current conditioning method for 2F34 is processing through the Waste Treatment Complex (WTC), where 200 litre drums 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).

Conditioning plants:

Plant Name	Location
Waste Treatment Complex 1 (WTC1)	Sellafield

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

5:1 GGBS/CEM I grout

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
500 l drum	2.3	0.20	0.50	6	-
500 l drum (basket for waste)	97.7	1.1	0.50	40	-

Range in container waste loading:

95% of current waste and 99% of future waste is assumed to be compatible with the current WTC supercompaction and grout process. Typically between 1 and 10 compacted 200 litre drums will be loaded in to a 500 litre drum, with an average of 5.7. The rest of the waste is estimated to be incompatible with supercompaction. It is assumed that such wastes will be grouted directly in to 500 litre drums with no volume reduction attempted.

Other information on packaging and conditioning:

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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.

Management Routes:

Disposal Route	Stream volume %	Raw density t/m ³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	= 100.0		2050
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
GDF	LLWR	~ 9.0	GREEN	It is estimated that ~18 drums will be consigned as LLW from 2F34 under the 2X40/1 waste stream. The work to introduce this new LLW waste stream is well advanced.

RADIOACTIVITY

Source: The principal nuclides are Pu-238, Pu-239, Pu-240, Pu-241, Pu-242 and Am-241.

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

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 assay suite) and the total Pu mass of the current stocks.

Chemical form of radionuclides:

- H-3: -
- C-14: -
- Cl-36: -
- Se-79: -
- Tc-99: -
- I-129: -
- Ra: -
- Th: -
- U: Metal, oxide.
- Np: -
- Pu: Metal, oxide.

WASTE STREAM 2F34 Plutonium Contaminated Materials; Drums									
Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	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					Ti 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	1.55E-07	B B 2	1.55E-07	C C 2
Ag 110m					U 236				
Cd 109					U 238	7.15E-06	B B 2	7.15E-06	C C 2
Cd 113m					Np 237	6.81E-07	B B 2	6.81E-07	C C 2
Sn 119m					Pu 236				
Sn 121m					Pu 238	1.13E+00	B B 2	1.13E+00	C C 2
Sn 123					Pu 239	2.46E-01	B B 2	2.46E-01	C C 2
Sn 126					Pu 240	3.57E-01	B B 2	3.57E-01	C C 2
Sb 125					Pu 241	1.85E+01	B B 2	1.85E+01	C C 2
Sb 126					Pu 242	6.20E-04	B B 2	6.20E-04	C C 2
Te 125m					Am 241	2.30E-01	B B 2	2.30E-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					Unsp a				
Eu 152					Unsp b/g				
Eu 154					Total a	1.96E+00	*	1.96E+00	*
Eu 155					Total b/g	1.85E+01	*	1.85E+01	*

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 the 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
* Total calculated from the 114 declared radionuclides