

WASTE STREAM	2D96.5	FGMSP Fuel Bearing Materials
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SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	37.0 m ³
Total future arisings:		0 m ³
Total waste volume:		37.0 m ³

Comment on volumes: No further waste is expected to arise. This waste stream consists of a number of different items (cemented bit bins, uncemented TMEC bins, cemented TMEC bins, paint tins) all of which will have varying volume uncertainty. 25% has been deemed to be a conservative estimate.

Uncertainty factors on volumes:	Stock (upper):	x 1.25	Arisings (upper)	x
	Stock (lower):	x 0.75	Arisings (lower)	x

WASTE SOURCE Legacy fuel cutting operations (bit bins) and general waste from decanning facilities (paint tins).

PHYSICAL CHARACTERISTICS

General description: Uranium pieces in cement (cemented bit bins), uranium/zirconium pieces (uncemented TMEC bins), uranium/zirconium pieces in cemented (cemented TMEC bins), miscellaneous waste e.g. floor sweepings (paint tins).

Physical components (%vol): Exact breakdown unknown and will vary according to whether the item in question is a cemented bit bin or uncemented TMEC bin or cemented TMEC bin or paint tin.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): >2

Comment on density: Based on the density of SDF exports (approx. 2 tonnes of fuel in an approx. 1m³ skip).

CHEMICAL COMPOSITION

General description and components (%wt): Cemented bit bins - irradiated uranium (will include daughter isotopes) in a cement matrix. TMECs - irradiated uranium (could include daughter isotopes) attached to a zirconium plug, sometimes in a cement matrix. Paint tins - miscellaneous waste e.g. floor sweepings.

Chemical state: -

Chemical form of radionuclides:
 H-3: Probably trace amounts in fuel
 C-14: Probably trace amounts in fuel
 Cl-36: Probably trace amounts in fuel
 Se-79: Probably trace amounts in fuel
 Tc-99: Probably trace amounts in fuel
 I-129: Probably trace amounts in fuel
 Ra: Probably trace amounts in fuel
 Th: Probably trace amounts in fuel
 U: As fuel
 Np: Probably trace amounts in fuel
 Pu: Probably trace amounts in fuel

Metals and alloys (%wt): Uranium and zirconium are metals. The bit bins and paint tins themselves are made of mild steel. The cement is Ordinary Portland Cement.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....			
Other ferrous metals.....	P		
Iron.....	TR		
Aluminium.....	TR		
Beryllium.....	TR		
Cobalt.....	TR		
Copper.....	TR		
Lead.....	TR		
Magnox/Magnesium.....	TR		
Nickel.....	TR		
Titanium.....	TR		
Uranium.....	P		
Zinc.....	TR		
Zircaloy/Zirconium.....	P		
Other metals.....	TR		

Organics (%wt): Organic materials are unlikely to be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics	0		
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.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		

Other materials (%wt): -

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	(%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.....	P		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	P	Water within bit bins	
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): -

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

Materials of interest for waste acceptance criteria: N/A

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....		
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	0	

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	NE
Soluble solids as bulk chemical compounds.....	NE

Hazardous substances /
non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....		
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....		
Caesium.....		
Selenium.....		
Chromium.....		
Molybdenum.....		
Thallium.....		
Tin.....		
Vanadium.....		
Mercury compounds.....		
Others.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		
EEE Type 2.....		
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		

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Complexing agents (%wt):

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....		

Potential for the waste to contain discrete items: Not yet determined.

PACKAGING AND CONDITIONING

Conditioning method: The material will be stored in Magnox skips which will in turn be loaded into Self-Shielded Boxes and stored in Interim Storage Facility (ISF).

- Plant Name: -
- Location: Sellafield
- Plant startup date: To be determined
- Total capacity (m³/y incoming waste): -
- Target start date for packaging this stream: -
- Throughput for this stream (m³/y incoming waste): -
- Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	Sellafield self-shielded box	100.0	NE	NE	NE

- Likely container type comment: -
- Range in container waste volume: -
- Other information on containers: -
- Likely conditioning matrix: -
- Other information: -
- Conditioned density (t/m³): -
- Conditioned density comment: -
- Other information on conditioning: -
- Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

RADIOACTIVITY

Source:	Spent uranium fuel pieces ("u-bits"), TMECs.
Uncertainty:	-
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 activity values have been taken from the "Maximum Package Radionuclide Content" tables for UBBs on pp. 251 – 255 of the BEP report ("Nature and Quantity Assessment of Box Encapsulation Plant Wastes and Waste Packages", RP/BEP-B873/TECH/00394/B, P. Swift, June 22nd 2017), because this is the most challenging of the relevant inventories and therefore its use is conservative.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	5.42E-01	BB 2			Gd 153				
Be 10	5.71E-06	BB 2			Ho 163	1.68E-09	BB 2		
C 14	6.12E-02	BB 2			Ho 166m	2.54E-05	BB 2		
Na 22					Tm 170				
Al 26					Tm 171	4.68E-11	BB 2		
Cl 36	8.24E-06	BB 2			Lu 174				
Ar 39	1.01E-26	BB 2			Lu 176				
Ar 42	8.84E-39	BB 2			Hf 178n				
K 40	1.35E-39	BB 2			Hf 182	4.31E-14	BB 2		
Ca 41	6.29E-05	BB 2			Pt 193				
Mn 53	4.24E-10	BB 2			Tl 204				
Mn 54	7.70E-20	BB 2			Pb 205	1.04E-23	BB 2		
Fe 55	1.10E-05	BB 2			Pb 210	5.57E-08	BB 2		
Co 60	1.21E-02	BB 2			Bi 208				
Ni 59	2.67E-03	BB 2			Bi 210m	9.47E-21	BB 2		
Ni 63	2.10E-01	BB 2			Po 210	5.26E-08	BB 2		
Zn 65		B 2			Ra 223	9.08E-07	BB 2		
Se 79	8.53E-03	BB 2			Ra 225	3.63E-09	BB 2		
Kr 81	2.75E-09	BB 2			Ra 226	2.48E-07	BB 2		
Kr 85	7.17E+00	BB 2			Ra 228	1.32E-11	BB 2		
Rb 87	5.19E-07	BB 2			Ac 227	9.10E-07	BB 2		
Sr 90	5.01E+02	BB 2			Th 227	8.96E-07	BB 2		
Zr 93	4.59E-02	BB 2			Th 228	6.44E-05	BB 2		
Nb 91	2.96E-15	BB 2			Th 229	3.63E-09	BB 2		
Nb 92	1.94E-13	BB 2			Th 230	1.96E-05	BB 2		
Nb 93m	4.15E-02	BB 2			Th 232	1.55E-11	BB 2		
Nb 94	2.86E-06	BB 2			Th 234	4.31E-02	BB 2		
Mo 93	1.44E-06	BB 2			Pa 231	1.45E-06	BB 2		
Tc 97	5.65E-12	BB 2			Pa 233	3.96E-03	BB 2		
Tc 99	3.74E-01	BB 2			U 232	6.28E-05	BB 2		
Ru 106	1.11E-12	BB 2			U 233	9.28E-07	BB 2		
Pd 107	2.80E-03	BB 2			U 234	3.75E-02	BB 2		
Ag 108m	4.09E-07	BB 2			U 235	8.06E-04	BB 2		
Ag 110m					U 236	5.58E-03	BB 2		
Cd 109	5.76E-19	BB 2			U 238	4.31E-02	BB 2		
Cd 113m	4.61E-02	BB 2			Np 237	3.96E-03	BB 2		
Sn 119m	3.88E-21	BB 2			Pu 236	2.58E-09	BB 2		
Sn 121m	3.58E-01	BB 2			Pu 238	1.42E+01	BB 2		
Sn 123					Pu 239	1.78E+01	BB 2		
Sn 126	2.04E-02	BB 2			Pu 240	2.85E+01	BB 2		
Sb 125	3.88E-04	BB 2			Pu 241	2.16E+02	BB 2		
Sb 126	2.85E-03	BB 2			Pu 242	2.61E-02	BB 2		
Te 125m	9.71E-05	BB 2			Am 241	8.72E+01	BB 2		
Te 127m					Am 242m	1.57E-01	BB 2		
I 129	8.24E-04	BB 2			Am 243	8.23E-02	BB 2		
Cs 134	1.83E-05	BB 2			Cm 242	1.30E-01	BB 2		
Cs 135	1.94E-02	BB 2			Cm 243	2.55E-02	BB 2		
Cs 137	7.58E+02	BB 2			Cm 244	4.01E-01	BB 2		
Ba 133	6.67E-09	BB 2			Cm 245	9.23E-05	BB 2		
La 137	9.35E-08	BB 2			Cm 246	9.29E-06	BB 2		
La 138	2.92E-12	BB 2			Cm 248	6.82E-12	BB 2		
Ce 144	4.62E-17	BB 2			Cf 249	1.54E-11	BB 2		
Pm 145	1.18E-09	BB 2			Cf 250	4.10E-12	BB 2		
Pm 147	3.75E-03	BB 2			Cf 251	2.01E-13	BB 2		
Sm 147	2.29E-07	BB 2			Cf 252	1.92E-17	BB 2		
Sm 151	6.32E+00	BB 2			Other a				
Eu 152	2.06E-02	BB 2			Other b/g				
Eu 154	1.29E+00	BB 2			Total a	1.49E+02	BB 2	0	
Eu 155	2.84E-02	BB 2			Total b/g	1.49E+03	BB 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