



**WASTE STREAM****2D27/C****Encapsulated Floc from Effluent Treatment**

General description and components (%wt):

Ferric and aluminoferric hydroxide floc, with adsorbed actinide ions (51%), PFA/OPC cement (49%).

Chemical state:

Alkali

Chemical form of radionuclides:

Tc-99: Technetium is present as technetate.  
U: Uranium is present as sodium diuranate.

Metals and alloys (%wt):

The waste contains no sheet or bulk metal.

Stainless steel.....

Other ferrous metals.....

Iron..... 0

Aluminium.....

Beryllium.....

Cobalt.....

Copper.....

Lead.....

Magnox/Magnesium.....

Nickel.....

Titanium.....

Uranium.....

Zinc.....

Zircaloy/Zirconium.....

Other metals.....

Organics (%wt):

Small quantities of organic complexants (&lt;1%) have been assumed to be a component of the floc.

Total cellulose.....

    Paper, cotton.....

    Wood.....

Halogenated plastics .....

Total non-halogenated plastics.....

    Condensation polymers.....

    Others.....

Organic ion exchange materials....

Total rubber.....

    Halogenated rubber .....

    Non-halogenated rubber.....

Hydrocarbons..... 0

    Oil or grease .....

    Fuel..... 0

    Asphalt/Tarmac (cont.coal tar)... 0

    Asphalt/Tarmac (no coal tar).... 0

    Bitumen..... 0

    Others..... 0

Other organics.....

Other materials (%wt):

-

**WASTE STREAM**

**2D27/C**

**Encapsulated Floc from Effluent Treatment**

Inorganic ion exchange materials.....	0
Inorganic sludges and flocs.....	51.0
Soil.....	0
Brick/Stone/Rubble.....	0
Cementitious material.....	49.0
Sand.....	
Glass/Ceramics.....	
Graphite.....	0
Desiccants/Catalysts.....	
Asbestos.....	0
Non/low friable.....	0
Moderately friable.....	0
Highly friable.....	0
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Includes small amounts of organic material (<1%).

**Inorganic anions (%wt):**

Nitrates, phosphates and sulphates are present. Others may be present in trace quantities.	
Fluoride.....	TR
Chloride.....	TR
Iodide.....	TR
Cyanide.....	TR
Carbonate.....	0
Nitrate.....	<1.0
Nitrite.....	TR
Phosphate.....	<0.10
Sulphate.....	<0.10
Sulphide.....	TR

**Materials of interest for waste acceptance criteria:**

No hazardous materials are present.	
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.....	
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0

**WASTE STREAM****2D27/C****Encapsulated Floc from Effluent Treatment**Hazardous substances /  
non hazardous pollutants:

Active particles.....		
Soluble solids as bulk chemical compounds.....		
Toxic metals are not present.		
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....	P	Trace.
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....		
Cadmium.....		
Caesium.....		
Selenium.....		
Chromium.....		
Molybdenum.....		
Thallium.....		
Tin.....		
Vanadium.....		
Mercury compounds.....		
Others.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	0	
EEE Type 2.....	0	
EEE Type 3.....	0	
EEE Type 4.....	0	
EEE Type 5.....	0	
Complexing agents (%wt):	Yes	
EDTA.....	0	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids.....		
Other organic complexants.....	TR	TBP, DBP and TPPBr may be present in trace amounts.
Total complexing agents.....	TR	

**PACKAGING AND CONDITIONING**

**WASTE STREAM****2D27/C****Encapsulated Floc from Effluent Treatment**

Container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	500 l drum	100.0	0.5	0.5	27948

Container type comment:

-

Range in container waste volume:

The amount of floc per drum varies between 0.35 - 0.354 m<sup>3</sup>.

Other information on containers:

Stainless steel

Conditioned density (t/m<sup>3</sup>):

1.4

Conditioned density comment:

-

Other information on conditioning:

-

**RADIOACTIVITY**

Source:

The main sources of activity will be actinide radionuclides, with some mixed fission products.

Medium active aqueous liquors arise from reprocessing in Magnox and Thorp and form the main feed for Bulks, SEC and MAC. Retrieved floc is an existing floc which arose from previous fuel reprocessing operations.

Uncertainty:

Best estimates. This waste stream contains waste from several different sources via EARP and hence can contain different ratios of all radioactive species.

Definition of total alpha and total beta/gamma:

Total alpha and total beta are derived from single analyses for all alpha and all beta emitting isotopes.

Measurement of radioactivities:

The various feeds (SEC, MAC, Bulks and retrieved floc) are sampled prior to treatment in EARP. The samples are analysed for the quoted species. The permeate from the floc due to dewatering is sampled and analysed. The amount in the floc is calculated from the difference between the feed and permeate inventories. I129 values updated based on paper TECH/09/67.

Other information:

Activity for Pu-239 includes that for Pu-240.

**WASTE STREAM**

**2D27/C**

**Encapsulated Floc from Effluent Treatment**

Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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	3.06E-03	CC 1	5.04E-03	CC 2	Gd 153				
Be 10					Ho 163				
C 14	3.14E-04	CC 1	3.14E-04	CC 2	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	1.46E-15	CC 1		
Co 60	2.30E-04	CC 1	6.42E-04	CC 2	Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210	1.27E-15	CC 1		
Zn 65					Ra 223	8.40E-15	CC 1		
Se 79					Ra 225	9.06E-11	CC 1		
Kr 81					Ra 226	1.44E-14	CC 1		
Kr 85					Ra 228				
Rb 87					Ac 227	8.49E-15	CC 1		
Sr 90	8.08E-02	CC 1	1.01E-01	CC 2	Th 227	8.31E-15	CC 1		
Zr 93					Th 228				
Nb 91					Th 229	9.15E-11	CC 1		
Nb 92					Th 230	7.20E-12	CC 1		
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231	3.20E-14	CC 1		
Tc 97					Pa 233	3.76E-03	CC 1		
Tc 99	5.39E-02	CC 1	8.59E-02	CC 1	U 232				
Ru 106	3.48E-03	CC 1	4.58E-02	CC 2	U 233	1.55E-07	CC 1		
Pd 107					U 234	1.22E-07	CC 1		
Ag 108m					U 235	2.02E-10	CC 1		
Ag 110m					U 236				
Cd 109					U 238				
Cd 113m					Np 237	3.78E-03	CC 1	3.78E-03	CC 2
Sn 119m					Pu 236				
Sn 121m					Pu 238	4.35E-03	CC 1	4.69E-03	CC 2
Sn 123					Pu 239	2.11E-02	CC 1	2.11E-02	CC 2
Sn 126					Pu 240				
Sb 125					Pu 241	4.65E-01	CC 1	7.18E-01	CC 2
Sb 126					Pu 242				
Te 125m					Am 241	2.35E-02	CC 1	1.54E-02	CC 2
Te 127m					Am 242m				
I 129	3.67E-06	EE 2	1.15E-05	CC 2	Am 243				
Cs 134	4.03E-04	CC 1	2.62E-03	CC 2	Cm 242				
Cs 135					Cm 243				
Cs 137	1.79E-01	CC 1	2.22E-01	CC 2	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	1.01E-04	CC 1	1.73E-03	CC 2	Cf 249				
Pm 145					Cf 250				
Pm 147	5.35E-03	CC 1	2.77E-02	CC 2	Cf 251				
Sm 147	5.53E-13	CC 1			Cf 252				
Sm 151					Other a				
Eu 152	1.12E-04	CC 1	1.78E-04	CC 2	Other b/g	1.58E-02	CC 1	1.58E-02	CC 2
Eu 154	8.35E-04	CC 1	1.66E-03	CC 2	<b>Total a</b>	<b>-5.27E-02</b>	<b>CC 1</b>	<b>-4.50E-02</b>	<b>CC 2</b>
Eu 155	5.21E-04	CC 1	1.54E-03	CC 2	<b>Total b/g</b>	<b>-8.13E-01</b>	<b>CC 1</b>	<b>-1.23E+00</b>	<b>CC 2</b>

**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