

WASTE STREAM

2F04/C

Encapsulated LWR Cladding

Stainless steel.....	4.5
Other ferrous metals.....	TR
Iron.....	
Aluminium.....	0
Beryllium.....	TR
Cobalt.....	0
Copper.....	0
Lead.....	0
Magnox/Magnesium.....	0
Nickel.....	0.60
Titanium.....	0
Uranium.....	0.04
Zinc.....	0
Zircaloy/Zirconium.....	26.9
Other metals.....	0

Inconel is type X750 or 718.

Organics (%wt):

There are no organic materials present except for nylon and polyurethane or hydrogenated nitrile rubber (from grout pigs) in very small amounts in drums of encapsulated product. Hydrogenated nitrile rubber and/or polyurethane.

Total cellulosics.....	0
Paper, cotton.....	0
Wood.....	0
Halogenated plastics	0
Total non-halogenated plastics.....	TR
Condensation polymers.....	TR
Others.....	TR
Organic ion exchange materials....	0
Total rubber.....	TR
Halogenated rubber	0
Non-halogenated rubber.....	TR
Hydrocarbons.....	
Oil or grease	
Fuel.....	
Asphalt/Tarmac (cont.coal tar)...	
Asphalt/Tarmac (no coal tar)....	
Bitumen.....	
Others.....	
Other organics.....	0

Other materials (%wt):

OPC/BFS used as conditioning material.	
Inorganic ion exchange materials.	0
Inorganic sludges and flocs.....	0
Soil.....	0
Brick/Stone/Rubble.....	0
Cementitious material.....	68.0

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	Sand.....	0	No sand present in encapsulation grout.
	Glass/Ceramics.....	0	
	Graphite.....	0	
	Desiccants/Catalysts.....	0	
	Asbestos.....	0	No asbestos present.
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	No inorganic anions are present, except for minor traces of nitrate.		
	Fluoride.....	0	
	Chloride.....	0	
	Iodide.....	0	
	Cyanide.....	0	
	Carbonate.....	0	
	Nitrate.....	TR	
	Nitrite.....	0	
	Phosphate.....	0	
	Sulphate.....	0	
	Sulphide.....	0	
Materials of interest for waste acceptance criteria:	The waste contains Zircaloy.		
	Combustible metals.....	P	0.269 (1% allowance for Zirconium fines).
	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.....	0	
	Corrosive materials.....	0	
	Pyrophoric materials.....	0	
	Generating toxic gases.....	0	
	Reacting with water.....	0	
	Active particles.....	P	Small fraction may be present.
	Soluble solids as bulk chemical compounds.....	P	Some calcium and sodium compounds.

WASTE STREAM**2F04/C****Encapsulated LWR Cladding**Hazardous substances /
non hazardous pollutants:

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Acrylamide.....

Benzene..... 0

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol..... 0

Styrene.....

Tri-butyl phosphate..... 0

Other organophosphates.....

Vinyl chloride..... 0

Arsenic..... 0

Barium.....

Boron..... 0

Cadmium..... 0

Caesium.....

Selenium..... 0

Chromium..... P

Trace present in OPC in
encapsulation grout.

Molybdenum..... 0

Thallium.....

Tin..... P

Trace present in OPC in
encapsulation grout.

Vanadium..... 0

Mercury compounds.....

Others..... 0

Electronic Electrical Equipment (EEE)

EEE Type 1.....

EEE Type 2.....

EEE Type 3.....

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt):

No

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids..... 0

Other organic complexants..... 0

Total complexing agents..... 0

PACKAGING AND CONDITIONING

WASTE STREAM	2F04/C	Encapsulated LWR Cladding
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Container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l drum	100.0	0.508	0.508	3594

Container type comment: Packaging factor 1.12.

Range in container waste volume: Volume is dependant on cutting length i.e. a better packing fraction can be achieved if hulls lengths are shorter but calculations are based on average cutting length.

Other information on containers: Stainless steel drums fitted with lid that has a filter fitted.

Conditioned density (t/m³): 2.5

Conditioned density comment: -

Other information on conditioning: Waste is already conditioned.

RADIOACTIVITY

Source: The main sources of activity will be fission product carry-over and activation products.

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 activities are calculated, based on characteristics of LWR fuel reprocessed to date for stocks and that still to be reprocessed for arisings.

Other information: -

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	2.82E+00	BB 2	6.24E+00	BB 2	Gd 153	4.54E-12	BB 2	4.62E-10	BB 2
Be 10	7.65E-09	BB 2	8.32E-09	BB 2	Ho 163	1.59E-12	BB 2	1.80E-12	BB 2
C 14	1.61E-02	BB 2	1.64E-02	BB 2	Ho 166m	9.12E-08	BB 2	1.47E-07	BB 2
Na 22					Tm 170		8		8
Al 26					Tm 171	4.72E-09	BB 2	1.52E-07	BB 2
Cl 36	4.57E-05	BB 2	4.59E-05	BB 2	Lu 174		8		8
Ar 39	8.81E-07	BB 2	1.04E-06	BB 2	Lu 176	1.22E-12	BB 2	1.35E-12	BB 2
Ar 42		8		8	Hf 178n		8		8
K 40	6.87E-12	BB 2	7.80E-12	BB 2	Hf 182	6.64E-17	BB 2	8.00E-17	BB 2
Ca 41	2.15E-05	BB 2	2.16E-05	BB 2	Pt 193		8		8
Mn 53	3.84E-15	BB 2	4.41E-15	BB 2	Tl 204		8		8
Mn 54	6.31E-03	BB 1	5.14E-01	BB 2	Pb 205		5		5
Fe 55	3.02E-01	BB 2	5.41E+00	BB 2	Pb 210	5.54E-11	BB 2	1.77E-11	BB 2
Co 60	4.96E+00	BB 1	3.92E+01	BB 2	Bi 208		8		8
Ni 59	8.04E-02	BB 2	8.32E-02	BB 2	Bi 210m		5		5
Ni 63	7.64E+00	BB 2	8.61E+00	BB 2	Po 210	5.30E-11	BB 2	1.77E-11	BB 2
Zn 65	3.51E-03	BB 1	3.53E-01	BB 2	Ra 223	1.11E-09	BB 2	7.45E-10	BB 2
Se 79	2.11E-06	BB 2	2.28E-06	BB 2	Ra 225	6.16E-12	BB 2	6.97E-12	BB 2
Kr 81	3.83E-12	BB 2	4.72E-12	BB 2	Ra 226	2.04E-10	BB 2	9.15E-11	BB 2
Kr 85	6.11E-02	BB 2	1.47E-01	BB 2	Ra 228	1.16E-14	BB 2	6.25E-15	BB 2
Rb 87	8.10E-10	BB 2	8.70E-10	BB 2	Ac 227	1.11E-09	BB 2	7.44E-10	BB 2
Sr 90	1.47E+00	BB 2	2.12E+00	BB 2	Th 227	1.10E-09	BB 2	7.35E-10	BB 2
Zr 93	8.72E-03	BB 2	9.44E-03	BB 2	Th 228	4.33E-07	BB 2	7.78E-07	BB 2
Nb 91	6.11E-18	BB 2	1.00E-17	BB 2	Th 229	6.17E-12	BB 2	6.97E-12	BB 2
Nb 92	1.81E-16	BB 2	2.02E-16	BB 2	Th 230	2.86E-08	BB 2	1.99E-08	BB 2
Nb 93m	6.36E-03	BB 2	5.11E-03	BB 2	Th 232	1.55E-14	BB 2	1.04E-14	BB 2
Nb 94	8.56E-03	BB 2	1.18E-02	BB 2	Th 234	2.39E-05	BB 2	2.52E-05	BB 2
Mo 93	3.92E-04	BB 2	6.03E-04	BB 2	Pa 231	2.50E-09	BB 2	2.25E-09	BB 2
Tc 97	5.27E-15	BB 2	5.89E-15	BB 2	Pa 233	7.26E-06	BB 2	8.22E-06	BB 2
Tc 99	5.26E-04	BB 2	5.68E-04	BB 2	U 232	4.14E-07	BB 1	4.25E-07	BB 2
Ru 106	2.02E-01	BB 1	1.41E+01	BB 2	U 233	1.55E-09	BB 1	8.64E-10	BB 2
Pd 107	2.95E-06	BB 2	3.33E-06	BB 2	U 234	9.16E-05	BB 1	5.72E-05	BB 2
Ag 108m	7.25E-01	BB 1	1.02E+00	BB 2	U 235	2.42E-06	BB 1	1.56E-06	BB 2
Ag 110m	3.03E-04	BB 1	2.99E-02	BB 2	U 236	9.57E-06	BB 1	6.24E-06	BB 2
Cd 109	2.14E-09	BB 2	1.18E-07	BB 2	U 238	2.39E-05	BB 1	1.35E-05	BB 2
Cd 113m	6.36E-04	BB 2	1.33E-03	BB 2	Np 237	7.26E-06	BB 2	8.22E-06	BB 2
Sn 119m	1.91E-06	BB 2	1.65E-04	BB 2	Pu 236	3.16E-08	BB 2	5.44E-07	BB 2
Sn 121m	3.15E-02	BB 2	4.07E-02	BB 2	Pu 238	8.45E-02	BB 1	1.29E-01	BB 2
Sn 123		8		8	Pu 239	4.12E-02	BB 1	4.26E-02	BB 2
Sn 126	1.03E-05	BB 2	1.15E-05	BB 2	Pu 240	4.22E-02	BB 1	4.31E-02	BB 2
Sb 125	7.08E-01	BB 1	1.29E+01	BB 2	Pu 241	2.11E+00	BB 1	4.47E+00	BB 2
Sb 126	1.44E-06	BB 2	3.67E-06	BB 2	Pu 242	8.55E-05	BB 1	1.04E-04	BB 2
Te 125m	1.69E-01	BB 2	3.76E-01	BB 2	Am 241	1.22E-01	BB 2	7.20E-02	BB 2
Te 127m		8		8	Am 242m	1.25E-04	BB 2	1.89E-04	BB 2
I 129	1.07E-06	BB 2	1.17E-06	BB 2	Am 243	2.50E-04	BB 2	3.72E-04	BB 2
Cs 134	6.25E-02	BB 1	1.90E+00	BB 2	Cm 242	1.03E-04	BB 2	1.55E-04	BB 2
Cs 135	2.08E-05	BB 2	2.50E-05	BB 2	Cm 243	1.29E-04	BB 2	2.66E-04	BB 2
Cs 137	1.46E+01	BB 1	2.36E+01	BB 2	Cm 244	6.22E-02	BB 1	2.49E-01	BB 2
Ba 133	3.55E-11	BB 2	9.16E-11	BB 2	Cm 245	2.33E-06	BB 2	4.92E-06	BB 2
La 137	8.95E-11	BB 2	9.99E-11	BB 2	Cm 246	3.58E-07	BB 2	8.36E-07	BB 2
La 138	8.66E-15	BB 2	1.12E-14	BB 2	Cm 248	2.12E-12	BB 2	6.12E-12	BB 2
Ce 144	4.12E-03	BB 1	3.64E-01	BB 2	Cf 249	1.94E-11	BB 2	6.06E-11	BB 2
Pm 145	8.99E-12	BB 2	2.07E-11	BB 2	Cf 250	3.79E-11	BB 2	2.04E-10	BB 2
Pm 147	8.90E-03	BB 2	1.57E-01	BB 2	Cf 251	7.13E-13	BB 2	2.31E-12	BB 2
Sm 147	2.90E-10	BB 2	2.93E-10	BB 2	Cf 252	5.43E-13	BB 2	1.29E-11	BB 2
Sm 151	1.26E-02	BB 2	1.57E-02	BB 2	Other a	4.27E-05	BB 2	5.18E-05	BB 2
Eu 152	1.03E+01	BB 1	3.24E-02	BB 2	Other b/g	1.81E-02	BB 2	1.99E-02	BB 2
Eu 154	1.21E-01	BB 1	5.78E-01	BB 2	Total a	3.53E-01	BB 2	5.37E-01	BB 2
Eu 155	2.31E-03	BB 2	1.51E-02	BB 2	Total b/g	4.65E+01	BB 2	1.22E+02	BB 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