

WASTE STREAM	2D74/C	Conditioned Pile Fuel Storage Pond Ion Exchange Material
---------------------	---------------	---

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~29.1		
Other ferrous metals.....			
Iron.....			
Aluminium.....			
Beryllium.....			
Cobalt.....			
Copper.....			
Lead.....			
Magnox/Magnesium.....			
Nickel.....			
Titanium.....	0		
Uranium.....			
Zinc.....			
Zircaloy/Zirconium.....			
Other metals.....			
Organics (%wt):	-		

	(%wt)	Type(s) and comment	% of total C14 activity
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.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....			

Other materials (%wt): -

WASTE STREAM	2D74/C	Conditioned Pile Fuel Storage Pond Ion Exchange Material
---------------------	---------------	---

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	~14.2	ionsiv IE- 911.	
Inorganic sludges and flocs.....	0.10		
Soil.....			
Brick/Stone/Rubble.....			
Cementitious material.....	56.6		
Sand.....	0		
Glass/Ceramics.....			
Graphite.....			
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....			
Free non-aqueous liquids.....			
Powder/Ash.....			

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: -

	(%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.....	0	

WASTE STREAM	2D74/C	Conditioned Pile Fuel Storage Pond Ion Exchange Material
---------------------	---------------	---

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.....		
Benzene.....	0	
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....	0	
Styrene.....		
Tri-butyl phosphate.....	0	
Other organophosphates.....		
Vinyl chloride.....	0	
Arsenic.....	0	
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	0	
Caesium.....		
Selenium.....	0	
Chromium.....	0	
Molybdenum.....	0	
Thallium.....		
Tin.....	0	
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.....		

WASTE STREAM	2D74/C	Conditioned Pile Fuel Storage Pond Ion Exchange Material
---------------------	---------------	---

Complexing agents (%wt):	No				
		(%wt)	Type(s) and comment		
EDTA.....					
DPTA.....					
NTA.....					
Polycarboxylic acids.....	0				
Other organic complexants.....	0				
Total complexing agents.....	0				

Potential for the waste to contain discrete items: No.

PACKAGING AND CONDITIONING

Container type:		Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	Container				
	500 l drum	100.0	~0.5	0.5	14

Container type comment: The current baseline strategy is that the used Ionsiv cartridges loaded with predominately Cs and Sr will initially be stored in the pond. The cartridges will be exported in a 250 litre liner to WEP. The envelope volume of 0.25m³ containing the ion exchange material loaded with beta activity will be immobilised in situ using either a cement grout formulation in a 500L Drum.

Range in container waste volume: -

Other information on containers: -

Conditioned density (t/m³): 2.3

Conditioned density comment: 1150 kg / 0.5m³.

Other information on conditioning: -

RADIOACTIVITY

Source: The activity originates from the corrosion of fuel and is predominately the soluble fission products Cs and Sr, which are transferred to the pond water. The pond water is then treated by passing through the Local Effluent Treatment Plant (LETP) which removes the Cs and Sr on to the Ionsiv contained in a purpose built cartridge.

Uncertainty: Having been operational for over 10 years, the Ionsiv's are proving highly effective in absorbing beta activity from the pond water. The radionuclides removed are predominately Cs and Sr. Each cartridge will be changed once the overall activity of each pair is analysed to be around 7-8TBq. Under certain operational circumstances this may be higher with the possibility of activity levels of 20TBq however it is more likely to be 11-12TBq as the Ionsivs will be "blinded" prior to reaching this activity level. Early removal of fuel from the pond has led to a revised downward estimation of lifetime cartridge requirements from previous submissions. As caesium 137 is preferentially removed over strontium 90 and the cartridges will always be changed on total activity, there will be a change in the Cs to Sr ratio over time. For stocks the ratio is 60:40.

Definition of total alpha and total beta/gamma: The nature and radiological fingerprint of the sludge differs with the pond areas, for instance, within the bays there is a higher fuel content within the sludge than there is within the pond, as activities in the bays is disturbed we may note different ratios of radionuclides on the cartridges. Sampling of these areas is an ongoing activity and this data will be utilised to ascertain the radiological fingerprint on the cartridges for disposal.

Measurement of radioactivities: The loading of activity onto the Ionsiv cartridge will be calculated by sampling and flow measurements. The samples will be analysed for total beta and alpha and other radionuclides and by spreadsheet calculations the quantities of radioactivity absorbed on to the Ionsiv cartridges will be calculated and monitored to ensure it remains below 7TBq

WASTE STREAM

2D74/C

**Conditioned Pile Fuel Storage Pond Ion Exchange
Material**

beta per pair of cartridges.

Other information:

The activity loaded on to the Ionsiv cartridges will be estimated from sampling and volume calculation (from flow meters). The calculated radionuclide inventory will be from analysis data comprising of total alpha, total beta and the individual isotopes Cs and Sr (the main nuclides involved).

WASTE STREAM 2D74/C Conditioned Pile Fuel Storage Pond Ion Exchange Material

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					Gd 153				
Be 10					Ho 163				
C 14	1.31E-05	AA 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				
Co 60	4.27E-05	AA 2			Bi 208				
Ni 59	6.06E-06	AA 2			Bi 210m				
Ni 63	4.86E-04	AA 2			Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	2.42E+00	AA 2			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	4.62E-06	AA 2			U 232				
Ru 106					U 233	6.54E-12	AA 2		
Pd 107					U 234	3.10E-06	AA 2		
Ag 108m					U 235	8.80E-08	AA 2		
Ag 110m					U 236	9.18E-08	AA 2		
Cd 109					U 238	2.70E-06	AA 2		
Cd 113m					Np 237	2.27E-08	AA 2		
Sn 119m					Pu 236	9.67E-16	AA 2		
Sn 121m					Pu 238	1.10E-05	AA 2		
Sn 123					Pu 239	7.02E-06	AA 2		
Sn 126					Pu 240	2.62E-04	AA 2		
Sb 125					Pu 241	6.70E-04	AA 2		
Sb 126					Pu 242	2.38E-08	AA 2		
Te 125m					Am 241	6.74E-04	AA 2		
Te 127m					Am 242m				
I 129	9.16E-09	AA 2			Am 243				
Cs 134	1.07E-03	AA 2			Cm 242				
Cs 135	8.02E-05	AA 2			Cm 243				
Cs 137	3.08E+00	AA 2			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	2.01E-04	AA 2			Other a				
Eu 152					Other b/g				
Eu 154	1.33E-06	AA 2			Total a	9.60E-04	AA 2	0	
Eu 155					Total b/g	5.50E+00	AA 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