

WASTE STREAM

2D74

Pile Fuel Storage Pond Ion Exchange Material

	Stainless steel.....	~67.0	
	Other ferrous metals.....		
	Iron.....		
	Aluminium.....		
	Beryllium.....		
	Cobalt.....		
	Copper.....		
	Lead.....		
	Magnox/Magnesium.....		
	Nickel.....		
	Titanium.....	0	
	Uranium.....		
	Zinc.....		
	Zircaloy/Zirconium.....		
	Other metals.....		
Organics (%wt):	-		
	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):	-		
	Inorganic ion exchange materials.	~33.0	Ionsiv IE- 911.
	Inorganic sludges and flocs.....		
	Soil.....		
	Brick/Stone/Rubble.....		
	Cementitious material.....		
	Sand.....	0	
	Glass/Ceramics.....		

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	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):	-	
	Fluoride.....	
	Chloride.....	
	Iodide.....	
	Cyanide.....	
	Carbonate.....	
	Nitrate.....	
	Nitrite.....	
	Phosphate.....	
	Sulphate.....	
	Sulphide.....	
Materials of interest for waste acceptance criteria:	-	
	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
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	0
	Active particles.....	0
	Soluble solids as bulk chemical compounds.....	0
Hazardous substances / non hazardous pollutants:	-	
	Acrylamide.....	
	Benzene.....	0
	Chlorinated solvents.....	

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

PACKAGING AND CONDITIONING

Conditioning method:	The designated route for the used IonSiv cartridges is to be conditioned in WEP for grouting to immobilise the ion exchange material inside the cartridge, and then 4 cartridges within product drums would be placed in a stillage and sent to EPS3 for storage until a repository is available. Transfers to WEP commenced in Q4 2018/19.
Plant Name:	Waste Encapsulation Plant
Location:	Sellafield
Plant startup date:	Available
Total capacity (m ³ /y incoming waste):	-

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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
	500 l drum	100.0	0.472	0.472	5

Likely container type comment: The existing route is that the used Ionsiv cartridges loaded with predominately Cs and Sr are 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 a cement grout formulation.

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: Cement

Other information: -

Conditioned density (t/m³): -

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: Not yet determined

Treatment	Stream volume (%)	Comment
-	-	-

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, for arisings this has been changed to 50:50.

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.

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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 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).

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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					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					Tl 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	4.47E+00	AA 1	5.40E+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					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235				
Ag 110m					U 236				
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137	5.30E+00	AA 1	5.40E+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					Other a				
Eu 152					Other b/g				
Eu 154					Total a	NE			NE
Eu 155					Total b/g	NE			NE

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