

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

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Ltd

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025		= 7.0	8.0
Future arisings:	1.4.2025 - 31.3.2026		= 0	0.0
	1.4.2026 - 31.3.2027		= 2.0	2.3
	1.4.2027 - 31.3.2028		= 0	0.0
Total future arisings:			2.0	2.3
Total waste volume:			9.0	10.3

Number of waste packages in stock: At 1.4.2025..... 14 packages

Comment on arising rates: As per the retrievals PSWP.

Additional information on quantities: Stock based upon annual stock take. Arisings based upon PSWP

Uncertainty factors on volumes:

Stock (upper):	x 1.00	Arisings (upper):	x 1.50
Stock (lower):	x 1.00	Arisings (lower):	x 0.50

WASTE SOURCE The waste is a cartridge 580mm diameter 993mm in height containing the ion exchange medium Ionsiv IE-911 (165kg). This becomes radioactive by removing predominately Cs and Sr from the pond water. The cartridge was designed to fit into a 250 litre liner for waste export from the plant in the 12te flask. One of the fourteen packages in stock is a dummy and has no associated inventory.

PHYSICAL CHARACTERISTICS

General description: The cartridge container has been designed so that it can be handled by the plant and its flasking equipment and is suitable for a number of disposal options. The secondary waste package is not yet confirmed but a couple of options are being progressed with the regulators.

Changes since waste generated: Once created the waste will be stable and when the cartridge is fully loaded (used up) it will be stored in the pond. There will be some generation of hydrogen from the radiolysis of water and this is allowed for in the design of the cartridge. The Ionsiv cartridges are placed into a 500L drum and grouted with typically 650kg of grout.

Bulk density (t/m³): ~ 2.0

Comment on density: The envelope volume of the cartridge is approximately 0.250m³ and its overall mass is approximately 500kg giving a bulk density of 500/0.250kg/m³ = 2,000kg/m³.

CHEMICAL COMPOSITION

General description and components (%wt): 67% cartridge is iron with small amounts of carbon, Cr. The Ionsiv (33% of weight) is made up as follows: TiO₂ 28.6 to 34.8% wt; SiO₂ 14.8 to 18.2% wt; Nb₂O₅ 18.5 to 22.7% wt; Na₂O 3.6% to 4.4% wt; ZrO₂ 14.1 to 18.8% wt; Cl 0.12 to 0.33% wt.

Chemical state: Neutral

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(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):

	(%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.....		-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

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	-
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	-

Complexing agents (%wt):

No

	(%wt)	Type(s) and comment
EDTA.....		-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....	= 0	-
Other organic complexants.....	= 0	-
Total complexing agents.....	= 0	-

Physical components:

	Number	Type(s) and comment
Sources.....		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1.....	= 0	-
EEE Type 2.....	= 0	-
EEE Type 3.....	= 0	-
EEE Type 4.....	= 0	-
EEE Type 5.....	= 0	-

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off-site	Stream volume %
Size reduction Decay storage Low force compaction Supercompaction (HFC) Incineration Drying/dewatering/liquid separation Tie down/fixatives/strippable coating/painting application Decontamination Metal treatment Recycling / reuse Thermal treatment, including vitrification Encapsulation Polymer encapsulation Other physical treatment Other chemical treatment Containerisation Treatment not yet determined None	On-site	= 100.0

Comments on planned treatments:

Encapsulation with cementitious grout at Wastes Encapsulation Plant

Conditioning method:

Entombment in cementitious grout at Wastes Encapsulation Plant

Conditioning plants:

Plant Name	Location
Wastes Encapsulation Plant (WEP)	Sellafield

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

BFS/OPC 4.5:1 (0.35% water solids ratio)

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
500 l drum	100.0	0.50	0.50	18	2025

Range in container waste loading:

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

2.3

Conditioned density comment:

1150 kg / 0.5m³.

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland) Expected to be Non-NSD HAW managed under Scottish Government's policy Expected to be disposed to LLW Vaults NRS Dounreay Expected to be consigned to the Geological Disposal Facility Expected to be consigned to a Near Surface Disposal Facility Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be disposed On-Site Expected to be managed by In-Situ Disposal Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be Out of Scope Expected to be recycled / reused Disposal route not known	= 100.0		2077

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: The activity originates from the corrosion of fuel and is predominantly 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 lonsiv contained in a purpose built cartridge.

Uncertainty: Having been operational for over 10 years, the lonsiv's are proving highly effective in absorbing beta activity from the pond water. The radionuclides removed are predominantly 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 lonsivs 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.

Measurement of radioactivities: The loading of activity onto the lonsiv 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 lonsiv cartridges will be calculated and monitored to ensure it remains below 7TBq beta per pair of cartridges.

Chemical form of radionuclides:

- H-3: -
- C-14: -
- Cl-36: -
- Se-79: -
- Tc-99: -
- I-129: -
- Ra: -
- Th: -
- U: -
- Np: -
- Pu: -

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3					Gd 153				
Be 10					Ho 163				
C 14	1.31E-05	A A 2	1.31E-05	A A 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					Ti 204				
Mn 54					Pb 205				
Fe 55					Pb 210	1.66E-15		1.66E-15	
Co 60	2.88E-05	A A 2	2.88E-05	A A 2	Bi 208				
Ni 59	6.06E-06	A A 2	6.06E-06	A A 2	Bi 210m				
Ni 63	4.76E-04	A A 2	4.76E-04	A A 2	Po 210	1.01E-15		1.01E-15	
Zn 65					Ra 223	2.40E-13		2.40E-13	
Se 79					Ra 225	1.85E-15		1.85E-15	
Kr 81					Ra 226	5.55E-14		5.55E-14	
Kr 85					Ra 228	2.18E-18		2.18E-18	
Rb 87					Ac 227	2.60E-13		2.60E-13	
Sr 90	2.25E+00	A A 2	2.25E+00	A A 2	Th 227	2.44E-13		2.44E-13	
Zr 93					Th 228	9.33E-18		9.33E-18	
Nb 91					Th 229	1.89E-15		1.89E-15	
Nb 92					Th 230	8.55E-11		8.55E-11	
Nb 93m					Th 232	1.36E-17		1.36E-17	
Nb 94					Th 234	2.70E-06		2.70E-06	
Mo 93					Pa 231	5.61E-12		5.61E-12	
Tc 97					Pa 233	2.33E-08		2.33E-08	
Tc 99	4.62E-06	A A 2	4.62E-06	A A 2	U 232	2.02E-17		2.02E-17	
Ru 106					U 233	6.83E-12	A A 2	6.83E-12	A A 2
Pd 107					U 234	3.10E-06	A A 2	3.10E-06	A A 2
Ag 108m					U 235	8.80E-08	A A 2	8.80E-08	A A 2
Ag 110m					U 236	9.18E-08	A A 2	9.18E-08	A A 2
Cd 109					U 238	2.70E-06	A A 2	2.70E-06	A A 2
Cd 113m					Np 237	2.33E-08	A A 2	2.33E-08	A A 2
Sn 119m					Pu 236	4.72E-16	A A 2	4.72E-16	A A 2
Sn 121m					Pu 238	1.07E-05	A A 2	1.07E-05	A A 2
Sn 123					Pu 239	7.02E-06	A A 2	7.02E-06	A A 2
Sn 126					Pu 240	2.62E-04	A A 2	2.62E-04	A A 2
Sb 125					Pu 241	5.80E-04	A A 2	5.80E-04	A A 2
Sb 126					Pu 242	2.38E-08	A A 2	2.38E-08	A A 2
Te 125m					Am 241	6.74E-04	A A 2	6.74E-04	A A 2
Te 127m					Am 242m				
I 129	9.16E-09	A A 2	9.16E-09	A A 2	Am 243				
Cs 134	3.92E-04	A A 2	3.92E-04	A A 2	Cm 242				
Cs 135	8.02E-05	A A 2	8.02E-05	A A 2	Cm 243				
Cs 137	2.88E+00	A A 2	2.88E+00	A A 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	1.97E-04	A A 2	1.97E-04	A A 2	Unsp a				
Eu 152					Unsp b/g				
Eu 154	1.05E-06	A A 2	1.05E-06	A A 2	Total a	9.60E-04	*	9.60E-04	*
Eu 155					Total b/g	5.13E+00	*	5.13E+00	*

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 the 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
* Total calculated from the 114 declared radionuclides