





**WASTE STREAM**

**2S09**

**Waste from P.I.E. Operations**

	Inorganic ion exchange materials.	0
	Inorganic sludges and flocs.....	0
	Soil.....	0
	Brick/Stone/Rubble.....	0
	Cementitious material.....	0
	Sand.....	
	Glass/Ceramics.....	0
	Graphite.....	0
	Desiccants/Catalysts.....	
	Asbestos.....	P
	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	TR
Inorganic anions (%wt):	Traces arising from decontaminants and etches etc.	
	Fluoride.....	TR
	Chloride.....	TR
	Iodide.....	TR
	Cyanide.....	TR
	Carbonate.....	TR
	Nitrate.....	TR
	Nitrite.....	TR
	Phosphate.....	TR
	Sulphate.....	TR
	Sulphide.....	TR
Materials of interest for waste acceptance criteria:	Powders will be present as contamination and dust from size reduction operations.	
	Combustible metals.....	0
	Low flash point liquids.....	0
	Explosive materials.....	0
	Phosphorus.....	0
	Hydrides.....	0
	Biological etc. materials.....	0
	Biodegradable materials.....	NE
	Putrescible wastes.....	0
	Non-putrescible wastes.....	NE
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	0
	Active particles.....	NE

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	Soluble solids as bulk chemical compounds.....	NE	
Hazardous substances / non hazardous pollutants:	The waste contains bulk lead and a small amount of mercury.		
	Acrylamide.....		
	Benzene.....	NE	
	Chlorinated solvents.....		
	Formaldehyde.....		
	Organometallics.....		
	Phenol.....	NE	
	Styrene.....		
	Tri-butyl phosphate.....	NE	
	Other organophosphates.....		
	Vinyl chloride.....	NE	
	Arsenic.....	NE	
	Barium.....		
	Boron.....	NE	
	Cadmium.....	NE	
	Caesium.....		
	Selenium.....	NE	
	Chromium.....	NE	
	Molybdenum.....	NE	
	Thallium.....		
	Tin.....	NE	
	Vanadium.....	NE	
	Mercury compounds.....		
	Others.....	NE	
	Electronic Electrical Equipment (EEE)		
	EEE Type 1.....		
	EEE Type 2.....		
	EEE Type 3.....		
	EEE Type 4.....		
	EEE Type 5.....		
Complexing agents (%wt):	Yes		
	EDTA.....		
	DPTA.....		
	NTA.....		
	Polycarboxylic acids.....		
	Other organic complexants.....	TR	
	Total complexing agents.....	TR	
			The waste contains traces of decontamination materials (<<1%).

**PACKAGING AND CONDITIONING**

Conditioning method: Conditioning plans for the bulk of the waste stream have not yet been decided. The graphite has been consigned to the LLWR.

Plant Name: Not yet determined.

Location: Windscale.

Plant startup date: -

Total capacity (m<sup>3</sup>/y incoming waste): -

Target start date for packaging this stream: 2042

Throughput for this stream (m<sup>3</sup>/y incoming waste): -

Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	Sellafield 3m <sup>3</sup> box	100.0	~0.85	2.1	30

Likely container type comment: Actual container type in unknown so Sellafield 3 m<sup>3</sup> boxes are assumed for calculation purposes.

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: Not specified

Other information: -

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

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: Not yet determined

Treatment	Stream volume (%)	Comment
-	-	-

**RADIOACTIVITY**

Source: Activation products of steel, PE16, Magnox, Zircaloy and contamination from U and UO<sub>2</sub> fuel.

Uncertainty: Average activity of some waste known with far greater accuracy. This radionuclide data is not applicable to the waste that originates from the Windscale Active Handling Facility.

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: Activity of 10% of waste assessed by FISPACT modelling, other 10% by sampling and analysis of contamination. No detail on radionuclide content of remaining 80%, so higher of derived data and 1998 inventory (unknown provenance) quoted. These percentage

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breakdowns are for the WAGR waste only not for the waste from the Windscale Active Handling Facility.

Other information:

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**WASTE STREAM 2S09 Waste from P.I.E. Operations**

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	1.43E-01	BA 2		6	Gd 153				
Be 10	9.30E-07	BA 2		6	Ho 163	4.69E-07	BA 2		6
C 14	4.19E-02	BA 2		6	Ho 166m	5.26E-05	BA 2		6
Na 22					Tm 170				
Al 26					Tm 171	5.79E-09	BA 2		6
Cl 36	6.00E-06	BA 2		6	Lu 174	2.04E-09	BA 2		6
Ar 39	3.78E-03	BA 2		6	Lu 176	2.90E-10	BA 2		6
Ar 42	1.40E-08	BA 2		6	Hf 178n	2.37E-04	BA 2		6
K 40	1.90E-08	BA 2		6	Hf 182	1.60E-10	BA 2		6
Ca 41	2.40E-04	BA 2		6	Pt 193	5.51E-04	BA 2		6
Mn 53	5.20E-08	BA 2		6	Tl 204	6.44E-05	BA 2		6
Mn 54	2.03E-13	BB 2		6	Pb 205	2.20E-09	BA 2		6
Fe 55	3.89E-03	BB 2	1.38E-05	BB 1	Pb 210	7.92E-10	BA 2		6
Co 60	2.06E-01	BB 2	1.57E-04	BB 1	Bi 208	5.70E-09	BA 2		6
Ni 59	2.00E-01	BA 2		6	Bi 210m	1.90E-09	BA 2		6
Ni 63	1.75E+01	BA 2		6	Po 210	7.39E-10	BA 2		6
Zn 65	1.43E-17	BA 2		6	Ra 223	6.45E-05			
Se 79	1.16E-07	BB 2	1.90E-07	BB 1	Ra 225	4.60E-08			
Kr 81	4.70E-07	BA 2		6	Ra 226	4.02E-09	BA 2		6
Kr 85	5.53E-05	BA 2		6	Ra 228	8.88E-08	BA 2		6
Rb 87	3.90E-08	BA 2		6	Ac 227	6.49E-05	BA 2		6
Sr 90	9.01E-04	BB 2	1.55E-03	BB 1	Th 227	6.38E-05			
Zr 93	9.30E-03	BA 2	3.90E-02	BB 1	Th 228	4.06E-06	BB 2		6
Nb 91	1.48E-05	BA 2		6	Th 229	4.60E-08	BB 2		6
Nb 92	2.70E-09	BA 2		6	Th 230	6.20E-07	BB 2	2.60E-06	BB 1
Nb 93m	5.72E-02	BA 2		6	Th 232	8.90E-08	BA 2		6
Nb 94	6.60E-03	BB 2	2.10E-06	BB 1	Th 234	7.10E-06			
Mo 93	9.77E-04	BA 2		6	Pa 231	1.70E-04	AC 2	7.10E-04	AC 1
Tc 97	1.50E-10	BA 2		6	Pa 233	3.95E-08			
Tc 99	1.30E-04	BB 2	1.10E-06	BB 1	U 232	3.91E-06	AC 2	1.16E-06	AC 1
Ru 106	1.72E-15	BA 2		6	U 233	7.10E-06	AC 2		6
Pd 107	3.40E-09	BA 2		6	U 234	1.90E-06	AC 2	6.81E-06	AC 1
Ag 108m	7.16E-05	BA 2		6	U 235	1.70E-07	AC 2	6.90E-07	AC 1
Ag 110m	6.81E-19	BB 2		6	U 236	1.21E-09	AC 2		6
Cd 109	5.25E-13	BA 2		6	U 238	7.10E-06	AC 2	2.90E-05	AC 1
Cd 113m	8.24E-05	BB 2	8.86E-05	BB 1	Np 237	3.95E-08	AC 2	1.62E-07	AC 1
Sn 119m	2.29E-17	BA 2		6	Pu 236				
Sn 121m	3.92E-05	BA 2		6	Pu 238	4.21E-05	AC 2	4.34E-05	AC 1
Sn 123					Pu 239	4.90E-05	AC 2	3.60E-05	AC 1
Sn 126	4.10E-09	BA 2		6	Pu 240	3.10E-05	AC 2	3.09E-05	AC 1
Sb 125	3.18E-07	BB 2	3.20E-06	BB 1	Pu 241	8.98E-04	AC 2	1.52E-03	AC 1
Sb 126	5.74E-10				Pu 242	4.20E-07	AC 2	1.50E-06	AC 1
Te 125m	7.97E-08				Am 241	1.41E-04	AC 2	2.67E-04	AC 1
Te 127m					Am 242m	1.04E-04	AC 2	6.69E-06	AC 1
I 129	4.30E-10	BA 2		6	Am 243	1.40E-06	AC 2	3.59E-06	AC 1
Cs 134	7.11E-08	BB 2	1.17E-09	BB 1	Cm 242	8.56E-05	AC 2	5.52E-06	AC 1
Cs 135	2.70E-08	BA 2		6	Cm 243	6.06E-07	AC 2	1.65E-06	AC 1
Cs 137	1.67E-03	BB 2	3.47E-03	BB 1	Cm 244	1.33E-05	AC 2	7.02E-06	AC 1
Ba 133	5.00E-04	BA 2		6	Cm 245	4.00E-08	AC 2	1.49E-07	AC 1
La 137	8.00E-06	BA 2		6	Cm 246	6.03E-08	AC 2	2.92E-07	AC 1
La 138	2.20E-12	BA 2		6	Cm 248				
Ce 144	2.27E-11	BB 2	3.79E-16	BB 1	Cf 249	1.07E-06	AC 2	4.37E-06	AC 1
Pm 145	1.06E-06	BA 2		6	Cf 250	9.53E-06	AC 2	1.87E-05	AC 1
Pm 147	5.87E-07	BB 2	6.11E-08	BB 1	Cf 251				
Sm 147	7.60E-11	BA 2		6	Cf 252				
Sm 151	3.55E-04	BB 2	4.34E-04	BB 1	Other a				
Eu 152	4.14E-03	BB 2	7.39E-04	BB 1	Other b/g				
Eu 154	3.57E-04	BB 2	1.84E-06	BB 1	<b>Total a</b>	<b>7.00E-04</b>	<b>CD 2</b>	<b>1.17E-03</b>	<b>CD 2</b>
Eu 155	2.93E-06	BB 2	1.07E-07	BB 1	<b>Total b/g</b>	<b>1.82E+01</b>	<b>CD 2</b>	<b>4.70E-02</b>	<b>CD 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