

WASTE STREAM	2S313	Windscale Piles Miscellaneous ILW
--------------	-------	-----------------------------------

SITE Windscale

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	= 6.8		
Future arisings:	1.4.2025 - 31.3.2042	= 0		
	1.4.2042 - 31.3.2053	~ 798.0		
Total future arisings:		798.0		
Total waste volume:		804.8		

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

Comment on arising rates: The stocks are made up from water duct debris and other waste from decommissioning on Piles and the Ex-PIE Facility that is currently stored within Pile 2. The waste arisings will be produced through decommissioning of the Piles reactors in line with the Piles optimised plan.

Additional information on quantities: The volumes given are envelope volumes.

Uncertainty factors on volumes: Stock (upper): x 1.50 Arisings (upper): x 1.50
Stock (lower): x 0.50 Arisings (lower): x 0.50

WASTE SOURCE Decommissioning of the Windscale Piles reactors.

PHYSICAL CHARACTERISTICS

General description: This is the non graphite/ fuel/ isotope component waste including metal core structural support components, such as external components including the control and shut-off rods and Burst Slug Scanning Gear. The waste is likely to be subject to fuel contamination following the fire in Pile 1. The concrete bioshield is now believed to be either Out of Scope or LLW. In addition to this the waste stream also includes the water duct debris and contents of 6 flasks currently stored in Pile 2.

Changes since waste generated: The waste in the pile reactors have remained in the reactors in a care and maintenance regime since they shut down. The waste in the Pile 1 reactor was subject to fire conditions.

Bulk density (t/m³): ~ 2.8

Comment on density: Density has been calculated from waste stream mass and envelope volume.

CHEMICAL COMPOSITION

General description and components (%wt): Carbon Steel (93.6%), Stainless steel (1%), Aluminium (0.6%), Cast Iron (2.1%), Boronated Steel (0.3%), Asbestos (1.4%), Fibreglass (0.7%), Mild steel (0.2%), Concrete (<0.1%), Lead (<0.1%), Polythene (<0.1%), Brass (lead) (<<0.1%), Cadmium (<0.1%), Water duct debris (<0.1%), Drummed waste (<<0.1%).

Chemical state: Neutral

Sheet metal proportion / thickness: The bulk metal items present includes the thermal shield, Al cascade vanes (12x 2.2x 2.2 m), Al N girders (6.4x 1.7x 0.9 m), BSSG (16.5x 0.36x 15.2 m), stainless steel bars (7.43m long), control and shutdown rods (10m long boronated steel sheathed in stainless steel), insulation boxes each made of 2 carbon steel sheets (vol 4.6m³ each), and the core contains 8.9 m³ carbon steel rebar.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 1.0	-	100.0
Other ferrous metals.....	~ 94.1	-	
Iron.....	~ 2.1	-	
Aluminium.....	~ 0.60	-	
Beryllium.....		-	
Cobalt.....	= 0	-	
Copper.....	<< 0.01	-	
Lead.....	< 0.10	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	= 0	-	
Titanium.....		-	
Uranium.....	P	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	<< 0.10	Brass (lead) and cadmium.	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	TR	-	
Paper, cotton.....	= 0	-	
Wood.....	TR	-	
Halogenated plastics.....	= 0	-	
Total non-halogenated plastics.....	< 0.10	-	
Condensation polymers.....		-	
Others.....		-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	TR	-	
Halogenated rubber.....	NE	-	
Non-halogenated rubber.....	NE	-	
Hydrocarbons.....		-	
Oil or grease.....		-	
Fuel.....		-	
Asphalt/Tarmac (cont.coal tar).....		-	
Asphalt/Tarmac (no coal tar).....		-	
Bitumen.....		-	
Others.....		-	
Other organics.....	< 0.10	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 0	-	
Inorganic sludges and flocs.....	NE	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	TR	-	
Cementitious material.....	< 0.10	-	
Sand.....		-	
Glass/Ceramics.....	~ 0.70	-	
Graphite.....	TR	-	
Desiccants/Catalysts.....		-	
Asbestos.....	~ 1.4	-	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
Free aqueous liquids.....	P	-	
Free non-aqueous liquids.....	= 0	-	
Powder/Ash.....	= 0	-	

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	= 0	-
Chloride.....	TR	-
Iodide.....	= 0	-
Cyanide.....	= 0	-
Carbonate.....	TR	-
Nitrate.....	= 0	-
Nitrite.....	= 0	-
Phosphate.....	= 0	-
Sulphate.....	= 0	-
Sulphide.....	= 0	-

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.....	NE	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....	NE	-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	= 0	-
Higher activity particles.....	NE	-
Soluble solids as bulk chemical compounds.....	NE	-

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....		-
Benzene.....	NE	-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....		-
Phenol.....	NE	-
Styrene.....		-
Tri-butyl phosphate.....	NE	-
Other organophosphates.....		-
Vinyl chloride.....	NE	-
Arsenic.....	NE	-
Barium.....		-
Boron.....	NE	-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	NE	-
Caesium.....		-
Selenium.....	NE	-
Chromium.....	NE	-
Molybdenum.....	NE	-
Thallium.....		-
Tin.....	NE	-
Vanadium.....	NE	-
Mercury compounds.....		-
Others.....	NE	-

Complexing agents (%wt):

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

Physical components:

	Number	Type(s) and comment
Sources.....	= 0	-
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		= 100.0

Comments on planned treatments:

Yet to be determined.

Conditioning method:

Yet to be confirmed.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

-

Further information on the conditioning matrix:

-

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
Sellafield 3 m³ box	100.0	0.48	2.2	1662	-

Range in container waste loading:

The loading will vary with the type of waste being packaged, and decommissioning and packaging strategy.

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

~ 2.3

Conditioned density comment:

Density assuming ferrous scrap and standard cementitious grout.

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		

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

Opportunities for alternative disposal routing: Not yet determined

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

RADIOACTIVITY

Source:	The radionuclide inventory is dominated by activation products. It is also influenced by the fuel contamination resulting from the fire in Pile 1.
Uncertainty:	The main source of uncertainty in the activation modelling is the elemental uncertainties in the material compositions. Wherever possible specific compositions and trace element data were used for each component.
Measurement of radioactivities:	AEA Technology was commissioned to undertake WIMS, ANISN and FISPIN modelling for the Pile reactor to establish the inventory of the main components and to establish the waste category of these components in support of the Piles LoC submissions.
Chemical form of radionuclides:	H-3: Present in the waste as an activation product. C-14: Present in the waste as an activation product. Cl-36: - Se-79: Present in the waste as an activation product. Tc-99: Present in the waste as an activation product. I-129: - Ra: Present in the waste as an activation product. Th: Present in the waste as an activation product. U: Present due to fuel contaminant. May be present as uranium metal and compounds from reaction. Np: Present in the waste as an activation product. Pu: Present in the waste as an activation product.

WASTE STREAM			2S313		Windscale Piles Miscellaneous ILW				
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	= 7.44E-03	B B 2	= 5.31E-03	B B 2	Gd 153				
Be 10	= 1.10E-07	B B 2	= 1.10E-07	B B 2	Ho 163	= 2.05E-07	B B 2	= 2.04E-07	B B 2
C 14	= 3.93E-03	B B 2	= 3.93E-03	B B 2	Ho 166m	= 2.23E-05	B B 2	= 2.23E-05	B B 2
Na 22					Tm 170				
Al 26					Tm 171	= 4.63E-13	B B 2	= 5.32E-14	B B 2
Cl 36	= 5.45E-07	B B 2	= 5.45E-07	B B 2	Lu 174	= 1.28E-12	B B 2	= 3.91E-13	B B 2
Ar 39	= 5.14E-04	B B 2	= 5.06E-04	B B 2	Lu 176	= 6.66E-11	B B 2	= 6.66E-11	B B 2
Ar 42	= 3.27E-10	B B 2	= 2.88E-10	B B 2	Hf 178n	= 2.12E-05	B B 2	= 1.85E-05	B B 2
K 40	= 7.51E-09	B B 2	= 7.51E-09	B B 2	Hf 182	= 8.46E-13	B B 2	= 8.46E-13	B B 2
Ca 41	= 2.30E-05	B B 2	= 2.30E-05	B B 2	Pt 193	= 2.49E-05	B B 2	= 2.29E-05	B B 2
Mn 53	= 1.14E-08	B B 2	= 1.14E-08	B B 2	Tl 204	= 1.18E-06	B B 2	= 3.93E-07	B B 2
Mn 54	= 9.37E-23	B B 2	= 7.25E-25	B B 2	Pb 205	= 4.85E-09	B B 2	= 4.85E-09	B B 2
Fe 55	= 8.31E-06	B B 2	= 1.81E-06	B B 2	Pb 210	= 7.84E-13	B B 2	= 7.50E-13	B B 2
Co 60	= 7.09E-03	B B 2	= 3.23E-03	B B 2	Bi 208	= 1.95E-10	B B 2	= 1.95E-10	B B 2
Ni 59	= 1.37E-02	B B 2	= 1.37E-02	B B 2	Bi 210m	= 6.96E-10	B B 2	= 6.96E-10	B B 2
Ni 63	= 1.10E+00	B B 2	= 1.06E+00	B B 2	Po 210	= 7.85E-13	B B 2	= 7.49E-13	B B 2
Zn 65	= 5.64E-30	B B 2	= 1.12E-32	B B 2	Ra 223	= 5.44E-10	B B 2	= 5.56E-10	B B 2
Se 79	= 2.21E-08	B B 2	= 2.21E-08	B B 2	Ra 225	= 5.62E-09	B B 2	= 5.25E-09	B B 2
Kr 81	= 7.13E-08	B B 2	= 7.13E-08	B B 2	Ra 226	= 7.80E-13	B B 2	= 8.58E-13	B B 2
Kr 85	= 1.35E-05	B B 2	= 9.19E-06	B B 2	Ra 228	= 1.73E-08	B B 2	= 1.73E-08	B B 2
Rb 87	= 1.31E-07	B B 2	= 1.31E-07	B B 2	Ac 227	= 5.44E-10	B B 2	= 5.57E-10	B B 2
Sr 90	= 1.08E-05	B B 2	= 9.44E-06	B B 2	Th 227	= 5.36E-10	B B 2	= 5.49E-10	B B 2
Zr 93	= 1.36E-08	B B 2	= 1.36E-08	B B 2	Th 228	= 2.23E-08	B B 2	= 2.17E-08	B B 2
Nb 91	= 2.73E-07	B B 2	= 2.71E-07	B B 2	Th 229	= 5.63E-09	B B 2	= 5.25E-09	B B 2
Nb 92	= 7.85E-11	B B 2	= 7.85E-11	B B 2	Th 230	= 4.67E-11	B B 2	= 4.40E-11	B B 2
Nb 93m	= 1.52E-03	B B 2	= 1.20E-03	B B 2	Th 232	= 1.73E-08	B B 2	= 1.73E-08	B B 2
Nb 94	= 1.86E-03	B B 2	= 1.86E-03	B B 2	Th 234	= 6.83E-08	B B 2	= 6.83E-08	B B 2
Mo 93	= 1.91E-04	B B 2	= 1.92E-04	B B 2	Pa 231	= 6.18E-10	B B 2	= 6.18E-10	B B 2
Tc 97	= 6.82E-11	B B 2	= 6.82E-11	B B 2	Pa 233	= 5.10E-11	B B 2	= 4.79E-11	B B 2
Tc 99	= 2.29E-05	B B 2	= 2.29E-05	B B 2	U 232	= 4.95E-09	B B 2	= 4.66E-09	B B 2
Ru 106	= 7.00E-24	B B 2	= 1.15E-25	B B 2	U 233	= 9.78E-07	B B 2	= 9.78E-07	B B 2
Pd 107	= 7.04E-10	B B 2	= 7.04E-10	B B 2	U 234	= 7.30E-08	B B 2	= 7.30E-08	B B 2
Ag 108m	= 1.99E-05	B B 2	= 1.97E-05	B B 2	U 235	= 3.13E-09	B B 2	= 3.13E-09	B B 2
Ag 110m	= 4.34E-31	B B 2	= 1.44E-33	B B 2	U 236	= 1.29E-10	B B 2	= 1.29E-10	B B 2
Cd 109	= 1.15E-18	B B 2	= 4.30E-20	B B 2	U 238	= 6.83E-08	B B 2	= 6.83E-08	B B 2
Cd 113m	= 3.58E-05	B B 2	= 2.65E-05	B B 2	Np 237	= 5.11E-11	B B 2	= 4.80E-11	B B 2
Sn 119m	= 6.94E-27	B B 2	= 3.88E-29	B B 2	Pu 236	= 1.10E-20	B B 2	= 2.63E-21	B B 2
Sn 121m	= 1.16E-05	B B 2	= 1.08E-05	B B 2	Pu 238	= 7.53E-08	B B 2	= 7.18E-08	B B 2
Sn 123					Pu 239	= 1.56E-05	B B 2	= 1.56E-05	B B 2
Sn 126	= 2.53E-11	B B 2	= 2.53E-11	B B 2	Pu 240	= 9.81E-07	B B 2	= 9.81E-07	B B 2
Sb 125	= 2.27E-09	B B 2	= 5.20E-10	B B 2	Pu 241	= 3.63E-06	B B 2	= 2.72E-06	B B 2
Sb 126					Pu 242	= 2.74E-10	B B 2	= 2.74E-10	B B 2
Te 125m	= 5.69E-10	B B 2			Am 241	= 2.52E-06	B B 2	= 2.53E-06	B B 2
Te 127m					Am 242m	= 2.19E-09	B B 2	= 2.13E-09	B B 2
I 129	= 2.24E-11	B B 2	= 2.24E-11	B B 2	Am 243	= 2.32E-10	B B 2	= 2.32E-10	B B 2
Cs 134	= 2.69E-11	B B 2	= 3.56E-12	B B 2	Cm 242	= 1.81E-09	B B 2	= 1.76E-09	B B 2
Cs 135	= 8.65E-10	B B 2	= 8.65E-10	B B 2	Cm 243	= 7.92E-11	B B 2	= 6.87E-11	B B 2
Cs 137	= 1.15E-05	B B 2	= 1.00E-05	B B 2	Cm 244	= 2.17E-10	B B 2	= 1.72E-10	B B 2
Ba 133	= 4.21E-05	B B 2	= 2.85E-05	B B 2	Cm 245	= 2.93E-14	B B 2	= 2.93E-14	B B 2
La 137	= 3.75E-07	B B 2	= 3.75E-07	B B 2	Cm 246	= 1.41E-15	B B 2	= 1.40E-15	B B 2
La 138	= 4.41E-13	B B 2	= 4.41E-13	B B 2	Cm 248	= 1.07E-22	B B 2	= 1.07E-22	B B 2
Ce 144	= 9.79E-29	B B 2	= 4.72E-31	B B 2	Cf 249	= 1.14E-22	B B 2	= 1.12E-22	B B 2
Pm 145	= 4.66E-07	B B 2	= 3.69E-07	B B 2	Cf 250				
Pm 147	= 1.17E-11	B B 2	= 2.38E-12	B B 2	Cf 251				
Sm 147	= 3.43E-11	B B 2	= 3.43E-11	B B 2	Cf 252				
Sm 151	= 2.88E-05	B B 2	= 2.76E-05	B B 2	Unsp a				
Eu 152	= 3.77E-04	B B 2	= 2.77E-04	B B 2	Unsp b/g				
Eu 154	= 3.79E-05	B B 2	= 2.34E-05	B B 2	Total a	2.03E-05	*	2.04E-05	*
Eu 155	= 5.53E-08	B B 2	= 2.34E-08	B B 2	Total b/g	1.14E+00	*	1.09E+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