

WASTE STREAM	2S09	Waste from P.I.E. Operations
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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	= 3.8		
Future arisings:	1.4.2025 - 31.3.2032	~ 0		
	1.4.2032 - 31.3.2044	~ 21.0		
Total future arisings:		21.0		
Total waste volume:		24.8		

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

Comment on arising rates: The figures have been aligned with the volumes recorded in the Hazard Inventory and the dates to coincide with the strategic plan.

Additional information on quantities: Most operational arisings are expected to be LLW. Small volumes may result from POCO, but cannot be quantified until extent/ methodology determined. This waste includes waste from WAGR and Waste from PIE and supporting operations in Windscale Active Handling Facility. The graphite from this waste stream has been packaged as LLW and consigned to the LLWR.

Uncertainty factors on volumes:

Stock (upper):	x 1.25	Arisings (upper):	x 1.25
Stock (lower):	x 0.75	Arisings (lower):	x 0.75

WASTE SOURCE Disassembly of WAGR stringers, and the PIE of WAGR fuels. Stream also contains WAGR operational wastes (mostly steel stringer components) that were in store ex-reactor at shut-down. The waste stream also includes waste from WAGR and waste from PIE and supporting operations in the Windscale Active Handling Facility. This also includes two neutron sources.

PHYSICAL CHARACTERISTICS

General description: Irradiated stainless steel, Zircaloy, Magnox, PE16 alloy, graphite (i.e. general fuel element furniture) and items of equipment contaminated with fission products and activation products (i.e. soft waste, gaiters, gloves and materials used for decontamination), waste associated with PIE operations.

Changes since waste generated: WAGR Wastes: WAGR hard wastes (~15vol%) have been size reduced and tubes squashed to fit in 65-litre m/s disposal cans. WAGR soft wastes (~5vol%) have been compacted in paint-cans and placed in similar disposal cans. Remaining 80%- any thin metal items (eg bottles) are compacted into blocks approximately 18" x 18" x 1" thick. Graphite waste has been consigned as LLW to the LLWR. Windscale Active Handling Facility Wastes: Approx 50% of this waste has been packaged into ILW storage boxes.

Bulk density (t/m³): ~ 2.0

Comment on density: Waste mass known accurately for substream representing ~10% of WAGR waste. Remainder deduced by analogy. No density data is currently available for the Windscale Active Handling Facility wastes.

CHEMICAL COMPOSITION

General description and components (%wt): WAGR Wastes: Stainless steel ~47%, mild steel incl. disposal cans ~24%, aluminium (<4%), other non-ferrous metal (<6%), paper (<6%), plastics (<8%), rubber (<3%), Magnox (<1%), Zircaloy (<1%). Contamination from U and UO2 fuel. The graphite has been removed and consigned to the LLWR. Windscale Active Handling Facility Wastes: Wastes from PIE operations (100%).

Chemical state: -

Sheet metal proportion / thickness: No sheet metal is consigned in this waste stream. No large items are present in the waste stream.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 47.0	20/25 Nb or 18/8.	
Other ferrous metals.....	~ 24.0	-	
Iron.....	-	-	
Aluminium.....	< 4.0	-	
Beryllium.....	P	-	
Cobalt.....	= 0	-	
Copper.....	P	-	
Lead.....	P	-	
Magnox/Magnesium.....	< 1.0	-	
Nickel.....	P	Tie rods are Nimonic PE16 alloy.	
Titanium.....	-	-	
Uranium.....	P	-	
Zinc.....	P	-	
Zircaloy/Zirconium.....	< 1.0	-	
Other metals.....	< 6.0	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	< 6.0	-	
Paper, cotton.....	< 6.0	-	
Wood.....	TR	-	
Halogenated plastics.....	NE	-	
Total non-halogenated plastics.....	< 8.0	-	
Condensation polymers.....	NE	-	
Others.....	NE	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	< 3.0	-	
Halogenated rubber.....	= 0	-	
Non-halogenated rubber.....	P	-	
Hydrocarbons.....	-	-	
Oil or grease.....	-	-	
Fuel.....	-	-	
Asphalt/Tarmac (cont.coal tar).....	-	-	
Asphalt/Tarmac (no coal tar).....	-	-	
Bitumen.....	-	-	
Others.....	-	-	
Other organics.....	= 0	-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
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	-	

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
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:

	(%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):

Yes		
	(%wt)	Type(s) and comment
EDTA.....	-	-
DPTA.....	-	-
NTA.....	-	-
Polycarboxylic acids.....	-	-
Other organic complexants.....	TR	The waste contains traces of decontamination materials (<<1%).
Total complexing agents.....	TR	-

Physical components:

	Number	Type(s) and comment
Sources.....	= 2	-
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	On-site	= 100.0
None		

Comments on planned treatments:

-

Conditioning method:

-

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	86.4	0.85	2.1	26	-
MBGWS box	13.6	0.20	2.8	17	-

Range in container waste loading: Waste to MBGWS may be used as infill rather than generating new boxes of waste.

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

-

Conditioned density comment:

-

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)	= 100.0		
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			

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:	Activation products of steel, PE16, Magnox, Zircaloy and contamination from U and UO2 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.
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 breakdowns are for the WAGR waste only not for the waste from the Windscale Active Handling Facility.
Chemical form of radionuclides:	H-3: - C-14: - Cl-36: - Se-79: - Tc-99: - I-129: - Ra: - Th: - U: Metal and oxide. Np: - Pu: Unknown.

WASTE STREAM		2S09		Waste from P.I.E. Operations					
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	= 1.20E-01	B A 2		6	Gd 153				
Be 10	= 9.30E-07	B A 2		6	Ho 163	= 4.69E-07	B A 2		6
C 14	= 4.19E-02	B A 2		6	Ho 166m	= 5.25E-05	B A 2		6
Na 22					Tm 170				
Al 26					Tm 171	= 1.96E-09	B A 2		6
Cl 36	= 6.00E-06	B A 2		6	Lu 174	= 1.14E-09	B A 2		6
Ar 39	= 3.75E-03	B A 2		6	Lu 176	= 2.90E-10	B A 2		6
Ar 42	= 1.31E-08	B A 2		6	Hf 178n	= 2.22E-04	B A 2		6
K 40	= 1.90E-08	B A 2		6	Hf 182	= 1.60E-10	B A 2		6
Ca 41	= 2.40E-04	B A 2		6	Pt 193	= 5.29E-04	B A 2		6
Mn 53	= 5.20E-08	B A 2		6	Tl 204	= 3.72E-05	B A 2		6
Mn 54	= 1.79E-14	B B 2		6	Pb 205	= 2.20E-09	B A 2		6
Fe 55	= 1.82E-03	B B 2	= 1.38E-05	B B 1	Pb 210	= 1.11E-09	B A 2		6
Co 60	= 1.39E-01	B B 2	= 1.57E-04	B B 1	Bi 208	= 5.70E-09	B A 2		6
Ni 59	= 2.00E-01	B A 2		6	Bi 210m	= 1.90E-09	B A 2		6
Ni 63	= 1.71E+01	B A 2		6	Po 210	= 1.05E-09	B A 2		6
Zn 65	= 6.39E-19	B A 2		6	Ra 223	= 7.41E-05			
Se 79	= 1.16E-07	B B 2	= 1.90E-07	B B 1	Ra 225	= 4.80E-08			
Kr 81	= 4.70E-07	B A 2		6	Ra 226	= 4.82E-09	B A 2		6
Kr 85	= 4.55E-05	B A 2		6	Ra 228	= 8.88E-08	B A 2		6
Rb 87	= 3.90E-08	B A 2		6	Ac 227	= 7.45E-05	B A 2		6
Sr 90	= 8.38E-04	B B 2	= 1.55E-03	B B 1	Th 227	= 7.32E-05			
Zr 93	= 9.30E-03	B A 2	= 3.90E-02	B B 1	Th 228	= 3.97E-06	B B 2		6
Nb 91	= 1.48E-05	B A 2		6	Th 229	= 4.80E-08	B B 2		6
Nb 92	= 2.70E-09	B A 2		6	Th 230	= 6.20E-07	B B 2	= 2.60E-06	B B 1
Nb 93m	= 5.15E-02	B A 2		6	Th 232	= 8.90E-08	B A 2		6
Nb 94	= 6.60E-03	B B 2	= 2.10E-06	B B 1	Th 234	= 7.10E-06			
Mo 93	= 9.77E-04	B A 2		6	Pa 231	= 1.70E-04	A C 2	= 7.10E-04	A C 1
Tc 97	= 1.50E-10	B A 2		6	Pa 233	= 3.96E-08			
Tc 99	= 1.30E-04	B B 2	= 1.10E-06	B B 1	U 232	= 3.79E-06	A C 2	= 1.16E-06	A C 1
Ru 106	= 2.19E-16	B A 2		6	U 233	= 7.10E-06	A C 2		6
Pd 107	= 3.40E-09	B A 2		6	U 234	= 1.90E-06	A C 2	= 6.81E-06	A C 1
Ag 108m	= 7.12E-05	B A 2		6	U 235	= 1.70E-07	A C 2	= 6.90E-07	A C 1
Ag 110m	= 3.26E-20	B B 2		6	U 236	= 1.21E-09	A C 2		6
Cd 109	= 1.02E-13	B A 2		6	U 238	= 7.10E-06	A C 2	= 2.90E-05	A C 1
Cd 113m	= 7.08E-05	B B 2	= 8.86E-05	B B 1	Np 237	= 3.96E-08	A C 2	= 1.62E-07	A C 1
Sn 119m	= 1.72E-18	B A 2		6	Pu 236				
Sn 121m	= 3.78E-05	B A 2		6	Pu 238	= 4.31E-05	A C 2	= 4.34E-05	A C 1
Sn 123					Pu 239	= 4.90E-05	A C 2	= 3.60E-05	A C 1
Sn 126	= 4.10E-09	B A 2		6	Pu 240	= 3.10E-05	A C 2	= 3.09E-05	A C 1
Sb 125	= 1.50E-07	B B 2	= 3.20E-06	B B 1	Pu 241	= 7.77E-04	A C 2	= 1.52E-03	A C 1
Sb 126	= 5.74E-10				Pu 242	= 4.20E-07	A C 2	= 1.50E-06	A C 1
Te 125m	= 3.75E-08				Am 241	= 1.44E-04	A C 2	= 2.67E-04	A C 1
Te 127m					Am 242m	= 1.02E-04	A C 2	= 6.69E-06	A C 1
I 129	= 4.30E-10	B A 2		6	Am 243	= 1.40E-06	A C 2	= 3.59E-06	A C 1
Cs 134	= 2.60E-08	B B 2	= 1.17E-09	B B 1	Cm 242	= 8.43E-05	A C 2	= 5.52E-06	A C 1
Cs 135	= 2.70E-08	B A 2		6	Cm 243	= 5.66E-07	A C 2	= 1.65E-06	A C 1
Cs 137	= 1.56E-03	B B 2	= 3.47E-03	B B 1	Cm 244	= 1.18E-05	A C 2	= 7.02E-06	A C 1
Ba 133	= 4.11E-04	B A 2		6	Cm 245	= 4.03E-08	A C 2	= 1.49E-07	A C 1
La 137	= 8.00E-06	B A 2		6	Cm 246	= 6.42E-08	A C 2	= 2.92E-07	A C 1
La 138	= 2.20E-12	B A 2		6	Cm 248				
Ce 144	= 1.58E-12	B B 2	= 3.79E-16	B B 1	Cf 249	= 1.07E-06	A C 2	= 4.37E-06	A C 1
Pm 145	= 9.45E-07	B A 2		6	Cf 250	= 8.13E-06	A C 2	= 1.87E-05	A C 1
Pm 147	= 2.66E-07	B B 2	= 6.11E-08	B B 1	Cf 251				
Sm 147	= 7.60E-11	B A 2		6	Cf 252				
Sm 151	= 3.47E-04	B B 2	= 4.34E-04	B B 1	Unsp a				
Eu 152	= 3.55E-03	B B 2	= 7.39E-04	B B 1	Unsp b/g				
Eu 154	= 2.80E-04	B B 2	= 1.84E-06	B B 1	Total a	7.19E-04	*	1.17E-03	*
Eu 155	= 1.91E-06	B B 2	= 1.07E-07	B B 1	Total b/g	1.77E+01	*	4.70E-02	*

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