

WASTE STREAM	2D35.2	MSSS Compartment 20
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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			
Future arisings:	~ 171.0			
Total future arisings:	0.0			
Total waste volume:	171.0			

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

Comment on arising rates: No further arisings to this stream.

Additional information on quantities: Waste volume includes unreacted decannings and swarf/sludge. Quantities are estimates from fuel decanning campaigns and storage volume records.

Uncertainty factors on volumes:

Stock (upper):	x 1.50	Arisings (upper):	x -
Stock (lower):	x 0.66	Arisings (lower):	x -

WASTE SOURCE Waste associated with Magnox fuel decanning and its subsequent underwater storage.

PHYSICAL CHARACTERISTICS

General description: The waste is debris from the process of decanning Magnox reactor fuel elements and has been stored under water since processing. The waste includes pieces of the Magnox can, fins and all other fuel element components, including fuel. Much of the waste that was originally consigned has been retrieved by SRF (and processed through MEP). Recent camera surveys show a low level of corrosion has occurred to the waste that still resides in the compartment.

Changes since waste generated: Swarf and uranium from Magnox decanning has reacted with storage cover water to form corrosion products.

Bulk density (t/m³): ~ 0.52

Comment on density: Bulk density is solids only - includes water content based on assumptions of draining characteristics. Bulk density including interstitial liquor = 1.25t/m³, bulk density with cover liquor and interstitial liquor = 1.09t/m³. Average decanning debris is ~1.6t/m³ and average MBGW is ~3.2t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Magnox swarf (13.26%), Magnox sludge (2.66%), Al/Al(OH)₃ (0%), U/UO₂/U₃O₈ (0.88%), MBGW (scrap, filters, cans, etc.) (0%), aggregate (limestone) (0%), water (82.89%), others (0.31%). Includes interstitial liquor and cover liquor. Total volume including cover liquor is 474 m³.

Chemical state: Neutral

Sheet metal proportion / thickness: No significant quantities of sheet metal. The waste is predominantly Magnox metal.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 0.02	Mainly SS316 and SS304.	
Other ferrous metals.....	~ 0.20	Carbon steels.	
Iron.....	NE	-	
Aluminium.....	= 0	-	
Beryllium.....	NE	-	
Cobalt.....	NE	-	
Copper.....	NE	-	
Lead.....	NE	-	
Magnox/Magnesium.....	~ 13.2	Predominantly Magnox.	
Nickel.....	NE	-	
Titanium.....	NE	-	
Uranium.....	~ 0.22	-	
Zinc.....	NE	-	
Zircaloy/Zirconium.....	~ 0.03	-	
Other metals.....	~ 0.03	-	

Organics (%wt):

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

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	NE	-	
Inorganic sludges and flocs.....	~ 3.3	-	
Soil.....	NE	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	NE	-	
Sand.....	NE	-	
Glass/Ceramics.....	~ 0.23	-	
Graphite.....	= 0	-	
Desiccants/Catalysts.....	NE	-	
Asbestos.....	NE	-	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
Free aqueous liquids.....	~ 82.7	Includes interstitial liquor and cover liquor. Total volume including cover liquor is 474 m3.	
Free non-aqueous liquids.....	NE	-	
Powder/Ash.....	NE	-	

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.....	NE	-
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.....	P	Trace, passivated.
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.....	P	<26%.
Higher activity particles.....	P	Radioactive sludges and solids.
Soluble solids as bulk chemical compounds.....	P	Hydroxides, chlorides and carbonates.

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	= 0	-
Benzene.....		-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....	= 0	-
Phenol.....		-
Styrene.....		-
Tri-butyl phosphate.....		-
Other organophosphates.....	= 0	-
Vinyl chloride.....		-
Arsenic.....	= 0	-
Barium.....		-
Boron.....	NE	-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	= 0	-
Caesium.....		-
Selenium.....	= 0	-
Chromium.....		P In steels.
Molybdenum.....	P	In steels.
Thallium.....	= 0	-
Tin.....		-
Vanadium.....		P In steels.
Mercury compounds.....	NE	-
Others.....		-

Complexing agents (%wt):

Not yet determined		
	(%wt)	Type(s) and comment
EDTA.....		-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....		-
Other organic complexants.....		-
Total complexing agents.....	NE	-

Physical components:

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

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction		100.0
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		

Comments on planned treatments:

-

Conditioning method:

The waste will be retrieved from MSSS and stored in an unconditioned state for a period of 70 years. Following the period of storage, it will be retrieved (from storage) and conditioned for ultimate disposal to the GDF.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

5:1 GGBS/CEM 1

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	Sellafield enhanced 3 m³ box	100.0	1.1	2.2	158	-

Range in container waste loading: There will be considerable variability in unconditioned waste volume per package due to variations in skip loading and content. The actual number of packages produced is identified in the Sellafield Decommissioning Product and Secondary Waste Plan. 119 Boxes plus 39 from residuals = 158 boxes.

Other information on packaging and conditioning: Waste matrix (as retrieved) will be in-filled with grout. A second pour of capping grout will be added. Void spaces between Skip wall and Box wall will be filled with grout.

Conditioned density (t/m³): ~ 2.0
 Conditioned density comment: Density of conditioned waste will be fairly uniform.

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: No

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

RADIOACTIVITY

Source: Sr-90, Cs-137, Co-60, Pu-239, Pu-240, Pu-241, Am-241.

Uncertainty: Accuracy is based on decanning records arisings, retrievals, retipping records and fuel carry over evaluations.

Measurement of radioactivities: Isotopic specific activity (TBq/m³) is derived by dividing the estimated total activity of the isotope by the total volume of the waste.

Chemical form of radionuclides:

- H-3: Present in elemental and reacted forms.
- C-14: Present in elemental and reacted forms.
- Cl-36: Present in elemental and reacted forms.
- Se-79: Present in elemental and reacted forms.
- Tc-99: Present in elemental and reacted forms.
- I-129: Present in elemental and reacted forms.
- Ra: Present in elemental forms.
- Th: Present in elemental and reacted forms.
- U: Present in metallic and reacted forms (oxides and possibly hydride).
- Np: Present in elemental and reacted forms.
- Pu: Present in metallic and mixed oxide forms.

WASTE STREAM		2D35.2		MSSS Compartment 20					
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	1.96E-02	A B 2			Gd 153	2.07E-19	A B 2		
Be 10	4.92E-07	A B 2			Ho 163	1.60E-11	A B 2		
C 14	4.48E-03	A B 2			Ho 166m	1.84E-07	A B 2		
Na 22					Tm 170	4.82E-35	A B 2		
Al 26					Tm 171	1.82E-10	A B 2		
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40	1.92E-08	A B 2			Hf 182	2.94E-16	A B 2		
Ca 41	2.08E-04	A B 2			Pt 193				
Mn 53	5.20E-12	A B 2			Tl 204	2.56E-14	A B 2		
Mn 54					Pb 205				
Fe 55	4.44E-04	A B 2			Pb 210	2.92E-10	A B 2		
Co 60	7.75E-02	A B 2			Bi 208				
Ni 59	7.66E-03	A B 2			Bi 210m	3.31E-23	A B 2		
Ni 63	7.44E-01	A B 2			Po 210	2.82E-10	A B 2		
Zn 65					Ra 223	4.01E-09	A B 2		
Se 79	1.04E-05	A B 2			Ra 225	1.07E-11	A B 2		
Kr 81					Ra 226	9.01E-10	A B 2		
Kr 85	1.41E-01	A B 2			Ra 228	2.02E-14			
Rb 87	3.85E-21	A B 2	Ac 227	4.03E-09	A B 2				
Sr 90	4.84E+00	A B 2	Th 227	3.96E-09	A B 2				
Zr 93	3.19E-04	A B 2	Th 228	3.38E-07	A B 2				
Nb 91			Th 229	1.07E-11	A B 2				
Nb 92	1.84E-15	A B 2	Th 230	9.90E-08	A B 2				
Nb 93m	2.61E-04	A B 2	Th 232	6.89E-14	A B 2				
Nb 94	2.48E-08	A B 2	Th 234	2.97E-04	A B 2				
Mo 93	4.88E-06	A B 2	Pa 231	7.78E-09	A B 2				
Tc 97			Pa 233	2.02E-05	A B 2				
Tc 99	2.68E-03	A B 2	U 232	3.28E-07	A B 2				
Ru 106	2.39E-09	A B 2	U 233	3.45E-09	A B 2				
Pd 107	2.48E-05	A B 2	U 234	2.61E-04	A B 2				
Ag 108m	3.99E-09	A B 2	U 235	6.37E-06	A B 2				
Ag 110m	1.22E-16	A B 2	U 236	3.50E-05	A B 2				
Cd 109	4.96E-17	A B 2	U 238	2.97E-04	A B 2				
Cd 113m	2.35E-14	A B 2	Np 237	2.03E-05	A B 2				
Sn 119m			Pu 236	5.66E-10	A B 2				
Sn 121m	1.75E-07	A B 2	Pu 238	8.74E-02	A B 2				
Sn 123			Pu 239	1.82E-01	A B 2				
Sn 126	1.73E-04	A B 2	Pu 240	2.36E-01	A B 2				
Sb 125	2.49E-04	A B 2	Pu 241	4.78E+00	A B 2				
Sb 126	2.42E-05	A B 2	Pu 242	2.13E-04	A B 2				
Te 125m	6.22E-05	A B 2	Am 241	8.10E-01	A B 2				
Te 127m			Am 242m	1.33E-03	A B 2				
I 129	6.32E-06	A B 2	Am 243	5.08E-04	A B 2				
Cs 134	3.48E-05	A B 2	Cm 242	1.10E-03	A B 2				
Cs 135	1.37E-04	A B 2	Cm 243	2.36E-04	A B 2				
Cs 137	8.03E+00	A B 2	Cm 244	3.57E-03	A B 2				
Ba 133	1.88E-10	A B 2	Cm 245	3.70E-07	A B 2				
La 137			Cm 246	3.16E-08	A B 2				
La 138	2.09E-14	A B 2	Cm 248	1.90E-23					
Ce 144	4.56E-12	A B 2	Cf 249	3.19E-14	A B 2				
Pm 145			Cf 250	1.77E-14	A B 2				
Pm 147	2.54E-03	A B 2	Cf 251	3.25E-16	A B 2				
Sm 147	7.61E-14		Cf 252	2.10E-18	A B 2				
Sm 151	6.12E-02	A B 2	Unsp a	1.83E-01					
Eu 152	3.42E-04	A B 2	Unsp b/g	1.33E+01					
Eu 154	3.04E-02	A B 2	Total a	1.50E+00	*				
Eu 155	2.49E-03	A B 2	Total b/g	3.21E+01	*				

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