

WASTE STREAM	9B59/C	FED Magnox
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SITE Bradwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025		= 5.2	13.2
Future arisings:				0.0
				0.0
Total future arisings:			0.0	0.0
Total waste volume:			5.2	13.2

Number of waste packages in stock: At 1.4.2025..... 10 packages

Comment on arising rates: -

Additional information on quantities: -

Uncertainty factors on volumes: Stock (upper): x 1.00 Arisings (upper): x -
Stock (lower): x 1.00 Arisings (lower): x -

WASTE SOURCE The source of the waste is the removal of splitters from fuel elements prior to dispatch of the elements for reprocessing. This waste was processed through the FED dissolution plant.

PHYSICAL CHARACTERISTICS

General description: The waste consists of Magnox metal and swarf which may be contaminated by fission products and actinides. Some waste from pond clean-up operations (relatively rich in uranium corrosion products) was tipped into Vault 8B, making the interface wastes too contaminated to allow separation. The wastes comprise various mixtures of the following: Magnox FED, FED oxidation product, waste from pond clean-up operations (principally pond sludge).

Changes since waste generated: -

Bulk density (t/m³): = 0.24

Comment on density: The density was calculated using the known waste mass and volume of the total waste stream.

CHEMICAL COMPOSITION

General description and components (%wt): Magnox metal (type ZR55) (>96%). Fission product and actinide contamination. The waste volume will includes a small fraction of Nimonic and zirconium alloys. Also contains IEX Resin from 56V (3%) and ADAP Sludge (2%).

Chemical state: Neutral

Sheet metal proportion / thickness: The thickness of some of the waste will be of the order of a mm or less.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0	-	
Other ferrous metals.....	= 0	-	
Iron.....	= 0	-	
Aluminium.....	= 0	-	
Beryllium.....	-	-	
Cobalt.....	-	-	
Copper.....	= 0	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	= 96.0	The waste is Magnox ZR55 which contains 0.55 wt% zirconium as an alloying constituent.	
Nickel.....	TR	Small quantities of Nimonic, a high nickel content alloy,	
Titanium.....	-	-	
Uranium.....	-	-	
Zinc.....	-	-	
Zircaloy/Zirconium.....	-	-	
Other metals.....	TR	Manganese	

Organics (%wt):

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

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 3.0	IEX resin from 56V	
Inorganic sludges and flocs.....	= 2.0	ADAP sludge	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	= 0	-	
Sand.....		-	
Glass/Ceramics.....	= 0	-	
Graphite.....	TR	-	
Desiccants/Catalysts.....		-	
Asbestos.....	= 0	-	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
Free aqueous liquids.....	TR	-	
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.....	= 0	-
Cyanide.....	= 0	-
Carbonate.....	TR	-
Nitrate.....	TR	-
Nitrite.....	TR	-
Phosphate.....	TR	-
Sulphate.....	TR	-
Sulphide.....	= 0	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	> 96.0	-
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.....		-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	> 96.0	-
Higher activity particles.....		-
Soluble solids as bulk chemical compounds.....		-

Hazardous substances / non hazardous pollutants:

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

Complexing agents (%wt):

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

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		
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:

Waste has been conditioned using AVDS.

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
	500 l RS drum (0mm Pb)	100.0	0.52	0.52	10	-

Range in container waste loading: -

Other information on packaging and conditioning: -

Conditioned density (t/m³): = 0.24
 Conditioned density comment: Calculated using known wastestream volume and mass.

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: The source of the waste is the removal of splitters from fuel elements prior to dispatch of the elements to Sellafield. Activation of trace nuclides in the Magnox and contamination by fission products and actinides will be main sources of activity. In addition activity in waste packages will also be derived from activated fuel element components e.g. nimonic springs and fuel fragments.

Uncertainty: Specific activities of all 10 waste packages were determined using gamma spectroscopy and fingerprints. The activities quoted do not include any allowance for the activity of Nimonic springs or zirconium alloy in top end fittings. However, the resulting average activities in the waste are thought to lie within the uncertainties associated with the average activity of the Magnox.

Measurement of radioactivities: Specific activities of all 10 waste packages were measured and derived using gamma spectroscopy and the application of fingerprints. The total activity for all packages was summed and divided by the waste stream volume to obtain specific activity. Decayed to 01/04/2025.

Chemical form of radionuclides: H-3: Tritium is expected to be present as surface contamination possibly as water but perhaps in the form of other inorganic compounds or as organic compounds.
 C-14: Carbon 14 will probably be present as graphite.
 Cl-36: Chlorine 36 incorporated in the Magnox may be associated with barium impurity (BaCl₂). Other chlorine 36 may be associated with surface contamination.
 Se-79: -
 Tc-99: -
 I-129: -
 Ra: -
 Th: -
 U: Chemical form of U isotopes has not been determined but are present as oxides.
 Np: -
 Pu: Chemical form of Pu isotopes has not been determined but may be oxides.

WASTE STREAM 9B59/C FED Magnox									
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	2.70E-02	C C 2			Gd 153		8		
Be 10		8			Ho 163	2.60E-09	C C 2		
C 14	5.71E-04	C C 2			Ho 166m	7.93E-07	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	1.06E-08	C C 2		
Cl 36	5.62E-06	C C 2			Lu 174		8		
Ar 39	1.03E-04	C C 2			Lu 176		8		
Ar 42	2.93E-09	C C 2			Hf 178n	1.55E-06	C C 2		
K 40	1.20E-09	C C 2			Hf 182		8		
Ca 41	3.76E-05	C C 2			Pt 193	6.27E-05	C C 2		
Mn 53		8			Ti 204	6.47E-07	C C 2		
Mn 54		8			Pb 205		8		
Fe 55	7.11E-04	C C 2			Pb 210		8		
Co 60	1.51E-03	C C 2			Bi 208		8		
Ni 59	2.70E-05	C C 2			Bi 210m		8		
Ni 63	3.78E-03	C C 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	2.67E-09	C C 2			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85	1.49E-04	C C 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	4.10E-02	C C 2			Th 227		8		
Zr 93	1.78E-06	C C 2			Th 228	3.33E-08	C C 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	2.73E-09	C C 2		
Nb 93m	2.74E-06	C C 2			Th 232		8		
Nb 94	1.79E-07	C C 2			Th 234	3.92E-06	C C 2		
Mo 93	5.15E-09	C C 2			Pa 231		8		
Tc 97		8			Pa 233	6.74E-07	C C 2		
Tc 99	4.86E-06	C C 2			U 232	3.24E-08	C C 2		
Ru 106		8			U 233	6.40E-08	C C 2		
Pd 107	6.51E-09	C C 2			U 234	3.44E-06	C C 2		
Ag 108m	1.11E-05	C C 2			U 235	1.06E-07	C C 2		
Ag 110m		8			U 236	3.91E-07	C C 2		
Cd 109		8			U 238	3.92E-06	C C 2		
Cd 113m	4.51E-07	C C 2			Np 237	6.75E-07	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	8.02E-08	C C 2			Pu 238	1.85E-03	C C 2		
Sn 123		8			Pu 239	2.23E-03	C C 2		
Sn 126	2.42E-08	C C 2			Pu 240	2.21E-03	C C 2		
Sb 125	8.61E-07	C C 2			Pu 241	2.33E-02	C C 2		
Sb 126	3.39E-09	C C 2			Pu 242	2.76E-06	C C 2		
Te 125m	2.16E-07	C C 2			Am 241	9.94E-03	C C 2		
Te 127m		8			Am 242m	1.76E-05	C C 2		
I 129	2.26E-09	C C 2			Am 243	5.20E-06	C C 2		
Cs 134	2.73E-07	C C 2			Cm 242	1.46E-05	C C 2		
Cs 135	6.09E-08	C C 2			Cm 243	1.42E-06	C C 2		
Cs 137	4.93E-03	C C 2			Cm 244	2.19E-05	C C 2		
Ba 133	4.90E-06	C C 2			Cm 245	2.21E-09	C C 2		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	1.89E-05	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	6.08E-04	C C 2			Unsp a				
Eu 152	1.42E-06	C C 2			Unsp b/g				
Eu 154	1.14E-04	C C 2			Total a	1.63E-02	*	0	*
Eu 155	1.18E-05	C C 2			Total b/g	1.04E-01	*	0	*

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