

WASTE STREAM	2C32	CEGB Cartridges (Bradwell)
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SITE Chapelcross

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			
Future arisings:				
Total future arisings:				
Total waste volume:				

0.0
< 0.1

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

Comment on arising rates: There will be no further arisings.

Additional information on quantities: -

Uncertainty factors on volumes: Stock (upper): x 1.20 Arisings (upper): x -
Stock (lower): x 0.80 Arisings (lower): x -

WASTE SOURCE The cartridges are modified Chapelcross Long Holding Down Weights (LHDWs) used in irradiation trials in the mid-1990s. They are mild steel rod canisters approximately 90 cm long.

PHYSICAL CHARACTERISTICS

General description: Mild steel rod canisters approximately 90 cm long.

Changes since waste generated: -

Bulk density (t/m³): = 6.1

Comment on density: Density calculated from mass of 59.1kg (0.059t) and volume of 0.0097m³.

CHEMICAL COMPOSITION

General description and components (%wt): -

Chemical state: Neutral

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....		-	
Other ferrous metals.....	= 100.0	mild steel	
Iron.....		-	
Aluminium.....		-	
Beryllium.....		-	
Cobalt.....		-	
Copper.....		-	
Lead.....		-	
Magnox/Magnesium.....		-	
Nickel.....		-	
Titanium.....		-	
Uranium.....		-	
Zinc.....		-	
Zircaloy/Zirconium.....		-	
Other metals.....		-	

Organics (%wt):

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

Other materials (%wt):

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

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

Inorganic anions (%wt):

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

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	-	-
Low flash point liquids.....	-	-
Explosive materials.....	-	-
Phosphorus.....	-	-
Hydrides.....	-	-
Biological etc. materials.....	-	-
Biodegradable materials.....	0	-
Putrescible wastes.....	-	-
Non-putrescible wastes.....	-	-
Corrosive materials.....	-	-
Pyrophoric materials.....	-	-
Generating toxic gases.....	-	-
Reacting with water.....	-	-
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):

No		
	(%wt)	Type(s) and comment
EDTA.....	0	-
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	On-site	100.0

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
	500 l drum	100.0	0.01	0.47	2	-

Range in container waste loading: -

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)	NE		
Expected to be Non-NSD HAW managed under Scottish Government's policy	NE		
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: Activation products.

Uncertainty: The CEGB cartridges were modified Long Holding Down Weights (LHDW), a standard reactor item, but with an internal void and therefore reduced overall mass (LHDW mass 18.4 kg, CEGB cartridge mass 14.8 kg (not including irradiation trial contents, which have already been removed)). The inventory of LHDW has been calculated based on a combination of materials analysis, irradiation modelling, and assay of all 183 LHDW in the ponds; this has been used as a basis for the inventory of the CEGB cartridges. The CEGB cartridges were irradiated in 1994/1995 whereas the LHDW would generally have been irradiated up to the end of generation in 2004. The fingerprints for LHDW therefore required an additional 10 years' decay to match the age of the cartridges at an equivalent date. Comparison of the age-matched activities of the CEGB cartridges and the LHDW shows good correlation, with the 'baseline' (calculated) 60Co activity being a near-exact match.

Measurement of radioactivities: -

Chemical form of radionuclides: H-3: Not determined.
C-14: Not determined.
Cl-36: -
Se-79: Not determined.
Tc-99: Not determined.
I-129: -
Ra: Not determined.
Th: Not determined.
U: Not determined.
Np: Not determined.
Pu: Not determined.

WASTE STREAM 2C32 CEGB Cartridges (Bradwell)									
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	1.59E+00	C C 2			Gd 153		8		
Be 10	1.01E-05	C C 2			Ho 163	1.99E-06	C C 2		
C 14	1.01E-01	C C 2			Ho 166m	8.43E-04	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	2.39E-08	C C 2		
Cl 36	5.84E-05	C C 2			Lu 174	4.34E-09	C C 2		
Ar 39	9.28E-05	C C 2			Lu 176		8		
Ar 42	2.18E-07	C C 2			Hf 178n	5.05E-04	C C 2		
K 40	1.19E-07	C C 2			Hf 182		8		
Ca 41	7.23E-05	C C 2			Pt 193	8.19E-03	C C 2		
Mn 53	1.27E-06	C C 2			Ti 204	1.21E-03	C C 2		
Mn 54		8			Pb 205	1.56E-08	C C 2		
Fe 55	8.23E-02	C C 2			Pb 210		8		
Co 60	1.15E+00	C C 2			Bi 208	2.62E-08	C C 2		
Ni 59	2.70E-02	C C 2			Bi 210m	1.68E-08	C C 2		
Ni 63	2.21E+00	C C 2			Po 210		8		
Zn 65		8			Ra 223	3.07E-08	C C 2		
Se 79	2.37E-06	C C 2			Ra 225	5.55E-08	C C 2		
Kr 81	2.48E-06	C C 2			Ra 226		8		
Kr 85	7.13E-04	C C 2			Ra 228	9.88E-09	C C 2		
Rb 87	7.97E-08	C C 2			Ac 227	3.07E-08	C C 2		
Sr 90	7.19E-04	C C 2			Th 227	3.03E-08	C C 2		
Zr 93	4.41E-07	C C 2			Th 228	3.03E-06	C C 2		
Nb 91	1.83E-05	C C 2			Th 229	5.56E-08	C C 2		
Nb 92	1.04E-09	C C 2			Th 230		8		
Nb 93m	4.33E-04	C C 2			Th 232	9.90E-09	C C 2		
Nb 94	2.57E-03	C C 2			Th 234	4.04E-08	C C 2		
Mo 93	5.85E-04	C C 2			Pa 231	3.91E-08	C C 2		
Tc 97		8			Pa 233	1.97E-09	C C 2		
Tc 99	2.00E-04	C C 2			U 232	2.94E-06	C C 2		
Ru 106		8			U 233	1.20E-05	C C 2		
Pd 107	1.25E-08	C C 2			U 234	3.87E-07	C C 2		
Ag 108m	2.22E-01	C C 2			U 235	1.05E-09	C C 2		
Ag 110m		8			U 236	3.87E-09	C C 2		
Cd 109		8			U 238	4.04E-08	C C 2		
Cd 113m	1.98E-02	C C 2			Np 237	1.97E-09	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	2.81E-04	C C 2			Pu 238	3.92E-06	C C 2		
Sn 123		8			Pu 239	1.47E-05	C C 2		
Sn 126	7.60E-09	C C 2			Pu 240	1.46E-05	C C 2		
Sb 125	2.96E-06	C C 2			Pu 241	1.37E-04	C C 2		
Sb 126	1.06E-09	C C 2			Pu 242	6.96E-09	C C 2		
Te 125m	7.41E-07	C C 2			Am 241	3.91E-05	C C 2		
Te 127m		8			Am 242m	3.99E-08	C C 2		
I 129	1.07E-09	C C 2			Am 243	1.31E-08	C C 2		
Cs 134	2.84E-07	C C 2			Cm 242	3.29E-08	C C 2		
Cs 135	2.16E-07	C C 2			Cm 243	4.37E-09	C C 2		
Cs 137	8.24E-04	C C 2			Cm 244	4.84E-08	C C 2		
Ba 133	4.60E-03	C C 2			Cm 245		8		
La 137	2.50E-07	C C 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	7.15E-06	C C 2			Cf 250		8		
Pm 147	1.01E-07	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.72E-04	C C 2			Unsp a				
Eu 152	4.25E-05	C C 2			Unsp b/g				
Eu 154	5.02E-03	C C 2			Total a	9.10E-05	*	0	*
Eu 155	5.84E-05	C C 2			Total b/g	5.43E+00	*	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