

WASTE STREAM	2C31	Cobalt Cartridges
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SITE Chapelcross
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW

Is the waste subject to Scottish Policy: Yes

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0.1 m ³
Total future arisings:		0 m ³
Total waste volume:		0.1 m ³
Comment on volumes:	The will be no further arisings	
Uncertainty factors on volumes:	Stock (upper): x 1.2	Arisings (upper) x
	Stock (lower): x 0.8	Arisings (lower) x

WASTE SOURCE Cobalt cartridges irradiated to produce high energy sources.

PHYSICAL CHARACTERISTICS

General description: Colbalt-60 pencils contained within magnox cartridges.
 Physical components (%vol): Magnox, Cobalt-60, Stainless Steel Pencil Liners
 Sealed sources: The waste does not contain sealed sources.
 Bulk density (t/m³): 1.8
 Comment on density: The mean density of 1.8t/m³ refers to the mass of the components divided by the volume as stored.

CHEMICAL COMPOSITION

General description and components (%wt): Metals
 Chemical state: Neutral
 Chemical form of radionuclides: H-3: Present
 C-14: Present
 Se-79: Not Present
 Tc-99: Present
 Ra: Not Present
 Th: Not Present
 U: Not Present
 Np: Not Present
 Pu: Not Present
 Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....			
Iron.....			
Aluminium.....			
Beryllium.....			
Cobalt.....	NE		
Copper.....			
Lead.....			
Magnox/Magnesium.....	NE		

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Nickel.....
Titanium.....
Uranium.....
Zinc.....
Zircaloy/Zirconium.....
Other metals..... ~100.0 Cobalt-60 pencils contained within
magnox cartridges.

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.....			

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Highly friable.....
 Free aqueous liquids.....
 Free non-aqueous liquids.....
 Powder/Ash.....

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: Magnox is present

(%wt) Type(s) and comment

Acrylamide.....
 Benzene.....
 Chlorinated solvents.....
 Formaldehyde.....

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Organometallics.....
 Phenol.....
 Styrene.....
 Tri-butyl phosphate.....
 Other organophosphates.....
 Vinyl chloride.....
 Arsenic.....
 Barium.....
 Boron..... 0
 Boron (in Boral).....
 Boron (non-Boral).....
 Cadmium.....
 Caesium.....
 Selenium.....
 Chromium.....
 Molybdenum.....
 Thallium.....
 Tin.....
 Vanadium.....
 Mercury compounds.....
 Others.....
 Electronic Electrical Equipment (EEE)
 EEE Type 1.....
 EEE Type 2.....
 EEE Type 3.....
 EEE Type 4.....
 EEE Type 5.....

Complexing agents (%wt): No

(%wt) Type(s) and comment

EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

Potential for the waste to contain discrete items: Yes. All Stainless items assumed DIs

PACKAGING AND CONDITIONING

Conditioning method: -
 Plant Name: -
 Location: Chapelcross.
 Plant startup date: -

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Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): -

Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l RS drum (120mm Pb)	100.0	0.02	0.166	6

Likely container type comment: -

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m³): 0.45

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

RADIOACTIVITY

Source: Radionuclide inventory determined through non-active characterisation and modeling assessment.

Uncertainty: Radionuclide inventory determined through non-active characterisation and modeling assessment.

Definition of total alpha and total beta/gamma: Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.

Measurement of radioactivities: Activation products. The above activities are specific activities and based on 48 cartridges with a volume of 0.12m³

Other information: -

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2C31

Cobalt Cartridges

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	1.70E-01	CC 2			Gd 153		8		
Be 10	3.33E-08	CC 2			Ho 163		8		
C 14	5.00E-08	CC 2			Ho 166m		8		
Na 22					Tm 170		8		
Al 26					Tm 171		8		
Cl 36	6.67E-08	CC 2			Lu 174		8		
Ar 39	1.61E-04	CC 2			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	8.33E-06	CC 2			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	1.97E-03	CC 2			Pb 210		8		
Co 60	3.46E+02	CC 2			Bi 208		8		
Ni 59	4.17E-02	CC 2			Bi 210m		8		
Ni 63	3.07E+00	CC 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90		8			Th 227		8		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	5.67E-04	CC 2			Th 232		8		
Nb 94	2.5E-04	CC 2			Th 234		8		
Mo 93	2.50E-04	CC 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	5E-06	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234		8		
Ag 108m	8.17E-04	CC 2			U 235		8		
Ag 110m		8			U 236		8		
Cd 109		8			U 238		8		
Cd 113m	4.56E-03	CC 2			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238		8		
Sn 123		8			Pu 239		8		
Sn 126		8			Pu 240		8		
Sb 125		8			Pu 241		8		
Sb 126		8			Pu 242		8		
Te 125m		8			Am 241		8		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134		8			Cm 242		8		
Cs 135		8			Cm 243		8		
Cs 137		8			Cm 244		8		
Ba 133	1.13E-05	CC 2			Cm 245		8		
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		8			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		8			Other a				
Eu 152		8			Other b/g				
Eu 154		8			Total a	0			0
Eu 155		8			Total b/g	3.49E+02	CC 2		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 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