

WASTE STREAM**9A44/C****Miscellaneous Activated Components****SITE** Berkeley**SITE OWNER** Nuclear Decommissioning Authority**WASTE CUSTODIAN** Magnox Limited**WASTE TYPE** ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	6.4 m ³	14.4 m ³
Total future arisings:		0 m ³	0 m ³
Total waste volume:		6.4 m ³	14.4 m ³
Number of waste packages in stock:	At 1.4.2022.....	11 package(s)	

Comment on volumes: Calculated using total weight from package records and density of wasteform

Uncertainty factors on volumes:	Stock (upper):	x 1.1	Arisings (upper)	x
	Stock (lower):	x 0.9	Arisings (lower)	x

WASTE SOURCE Irradiated components removed from the reactors.**PHYSICAL CHARACTERISTICS**

General description: The waste comprises mainly charge chutes, a thermocouple chute and a number of control rods, removed from reactor cores. Many of the control rods have been highly activated at one end. There are also pieces of the Mortuary Mechanism Cradle Gate assembly resting on top of this waste pile. These sections are identified in Waste Stream 9A81.

The waste consists of large, heavy items. The control rods are 8.5m in length and have a mass of approximately 80kg each. The charge chutes and trailing lead thermocouple chutes are 12m in length and have masses of approximately 1780kg and 1270kg respectively.

Physical components (%wt): Hot control rods (38% mass), cold control rod sections (61% mass), chute sections (1% mass)

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.48

Comment on density: Taken from BC/PROG/MIMP/CALC/0325 v3 - datasheets for Chute Silo MAC, tab Package PhysChem, Cell C75

CHEMICAL COMPOSITION

General description and components (%wt): The waste is principally steel (~100%). There may also be surface water and oil, cutting debris and secondary wastes.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium may be incorporated in the waste or present as surface contamination in the form of inorganic or organic compounds.

C-14: Chemical form of carbon 14 has not been determined but may be graphite.

Cl-36: The chemical form of chlorine 36 has not been determined.

Se-79: The chemical form of selenium-79 has not been determined.

Tc-99: The chemical form of technetium-99 has not been determined.

Ra: The chemical form of radium isotopes have not been determined.

Th: The chemical form of thorium isotopes have not been determined.

U: Chemical form of uranium isotopes has not been determined but may be uranium oxides.

Np: The chemical form of neptunium isotopes have not been determined.

Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): All of the waste is engineered components.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~45.4	EN58B Stainless steel	
Other ferrous metals.....	~55.0	EN3 Mild steel (0.9% wt); 4.25% Boron Cr steel (45.3% wt); EN56D 13% Cr steel (8.3% wt); 16/4/1 Tungsten steel (0.3% wt); Cast Iron (0.2%)	
Iron.....			
Aluminium.....	NE		
Beryllium.....	TR		
Cobalt.....			
Copper.....	NE		
Lead.....	NE		
Magnox/Magnesium.....	NE		
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	NE		
Zircaloy/Zirconium.....	NE		
Other metals.....	NE	The presence of "other" metals has not been assessed.	

Organics (%wt): There may be small quantities (<1 wt%) of organic materials present but none has been identified.

	(%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	There are no halogenated rubbers or plastics present.	
Condensation polymers.....	0		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0	There are no halogenated rubbers or plastics present.	
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.....			

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Other materials (%wt): Traces of graphite may be present.

	(%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.....	~0.20	iron shot concrete	
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	TR		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	TR		
Powder/Ash.....	0		

Inorganic anions (%wt): Inorganic anions are not expected to be present in more than trace quantities.

	(%wt)	Type(s) and comment
Fluoride.....	TR	
Chloride.....	TR	
Iodide.....	TR	
Cyanide.....	0	
Carbonate.....	TR	
Nitrate.....	TR	
Nitrite.....	TR	
Phosphate.....	TR	
Sulphate.....	TR	
Sulphide.....	TR	

Materials of interest for waste acceptance criteria: There are no hazardous materials present, however care should be taken during the size reduction operations to minimise the accumulation of swarf.

	(%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.....	0	
Putrescible wastes.....	0	

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Non-putrescible wastes.....
 Corrosive materials..... 0
 Pyrophoric materials..... 0
 Generating toxic gases..... 0
 Reacting with water..... 0
 Higher activity particles.....
 Soluble solids as bulk chemical
 compounds.....

Hazardous substances / None expected
 non hazardous pollutants:

(%wt) Type(s) and comment

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

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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. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIs.

PACKAGING AND CONDITIONING

Container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l RS drum (0mm Pb)	55.0	0.6	0.6	6
	500 l RS drum (50mm Pb)	45.0	0.58	0.58	5

Container type comment: -

Range in container waste volume: -

Other information on containers: The waste is non-encapsulated and package mass includes 0.154 te mild steel basket

Conditioned density (t/m³): 1.48

Conditioned density comment: Taken from MES/EST/MIMP/REP/0055/12 Issue 1

Other information on conditioning: -

RADIOACTIVITY

Source: Irradiated components removed from the reactor. Control rods are likely to be components of high activity.

Uncertainty: Specific activity is a function of station operating history. The values quoted are based on 2006 characterisation data, decayed to 2022, scaled to Co-60 content of each waste package and summed to output waste stream total.

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: Estimates are based upon theoretical assessments.

Other information: -

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Miscellaneous Activated Components

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	6.59E-04	CC 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	9.12E-02	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	2.26E-06	CC 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	2.51E-03	CC 2			Pb 210		8		
Co 60	4.37E-01	CC 1			Bi 208		8		
Ni 59	1.13E-01	CC 2			Bi 210m		8		
Ni 63	9.08E+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	1.07E-02	CC 2			Th 232		8		
Nb 94	8.83E-05	CC 2			Th 234		8		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234		8		
Ag 108m		8			U 235	1.63E-09	CC 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238		8		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	2.25E-05	CC 2		
Sn 123		8			Pu 239	2.81E-05	CC 2		
Sn 126		8			Pu 240	3.37E-05	CC 2		
Sb 125		8			Pu 241	2.58E-04	CC 2		
Sb 126		8			Pu 242		8		
Te 125m		8			Am 241	1.06E-04	CC 2		
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	3.68E-04	CC 2			Cm 244		8		
Ba 133		8			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	1.90E-04	CC 2	0	
Eu 155		8			Total b/g	9.73E+00	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