## WASTE STREAM 2D77/C Encapsulated Retrieved Miscellaneous Beta/Gamma Waste

| | |
|---|---|
| **SITE** | Sellafield |
| **SITE OWNER** | Nuclear Decommissioning Authority |
| **WASTE CUSTODIAN** | Sellafield Limited |
| **WASTE TYPE** | ILW |
| Is the waste subject to Scottish Policy: | No |

**WASTE VOLUMES**

| | | Conditioned | Packaged |
|---|---|---|---|
| Stocks: | At 1.4.2022..... | 0.5 $m^3$ | 0.6 $m^3$ |
| Total future arisings: | | 0 $m^3$ | 0 $m^3$ |
| Total waste volume: | | 0.5 $m^3$ | 0.6 $m^3$ |
| Number of waste packages in stock: | At 1.4.2022..... | 1 package(s) | |

Comment on volumes: Single trial drum completed. No further arisings - WEP not selected as the waste disposal route.

Uncertainty factors on volumes:

| | | | |
|---|---|---|---|
| Stock (upper): | x 1.1 | Arisings (upper) | x |
| Stock (lower): | x 0.9 | Arisings (lower) | x |

**WASTE SOURCE** Waste metal items removed from storage pond, consigned to WEP in a scrap basket, which is subsequently grouted in a 500 litre drum.

### PHYSICAL CHARACTERISTICS

General description: It will be metallic waste mainly comprising of mild steel and stainless steel items. These items will fit into a standard scrap bucket and will fit into a 500 litre drum for grouting operations. This will be final product, therefore no changes expected.

Physical components (%wt): Concrete 76%, Stainless steel 12%, Mild steel 11%, Others 1% (eg phosphor bronze bearings).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/$m^3$): 2.6

Comment on density: Density of conditioned waste . Raw waste ~1.6t/$m^3$.

### CHEMICAL COMPOSITION

General description and components (%wt): Grout 76%, Stainless steel 12%, Mild Steel 11%, Others 1% (eg phosphor bronze).

Chemical state: Alkali

Chemical form of radionuclides:
H-3: Not estimated.
C-14: Not estimated.
Cl-36: Present in trace amounts as clathrate compounds of metallic salts readilty lost to aqueous solution.
Se-79: Not estimated.
Tc-99: Not estimated.
I-129: Present in trace amounts as clathrate compounds of metallic salts readilty lost to aqueous solution.
Ra: Not estimated.
Th: Not estimated.
U: Not estimated.
Np: Not estimated.
Pu: Not estimated.

Metals and alloys (%wt): Not expected in sheet form, ususally in variable sized pieces.

## WASTE STREAM 2D77/C Encapsulated Retrieved Miscellaneous Beta/Gamma Waste

| | (%wt) | Type(s) / Grade(s) with proportions | % of total C14 activity |
|---|---|---|---|
| Stainless steel | 12.0 | 316L, 304. | |
| Other ferrous metals | 11.0 | Mild steel, carbon steel. | |
| Iron | | | |
| Aluminium | NE | | |
| Beryllium | TR | | |
| Cobalt | NE | | |
| Copper | NE | | |
| Lead | | | |
| Magnox/Magnesium | NE | | |
| Nickel | NE | | |
| Titanium | NE | | |
| Uranium | <0.01 | | |
| Zinc | NE | | |
| Zircaloy/Zirconium | NE | | |
| Other metals | 0.99 | Phosphorbronze. Niobium and molybdenum may be present in trace amounts. | |

Organics (%wt): Traces of rubbers from hose attachments and valve liners are present.

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

Other materials (%wt): Small amounts of graphite may be included. However, it's not anticipated to be in large amounts.

**WASTE STREAM 2D77/C Encapsulated Retrieved Miscellaneous Beta/Gamma Waste**

| | (%wt) | Type(s) and comment | % of total C14 activity |
|---|---|---|---|
| Inorganic ion exchange materials.. | NE | | |
| Inorganic sludges and flocs..... | NE | | |
| Soil..... | NE | | |
| Brick/Stone/Rubble..... | NE | | |
| Cementitious material..... | 76.0 | | |
| Sand..... | 0 | No sand present in encapsulation grout. | |
| Glass/Ceramics..... | NE | | |
| Graphite..... | TR | | |
| Desiccants/Catalysts..... | NE | | |
| Asbestos..... | 0 | | |
| Non/low friable..... | | | |
| Moderately friable..... | | | |
| Highly friable..... | | | |
| Free aqueous liquids..... | 0 | | |
| Free non-aqueous liquids..... | 0 | | |
| Powder/Ash..... | 0 | | |

Inorganic anions (%wt): -

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

Materials of interest for waste acceptance criteria: None determined.

| | (%wt) | Type(s) and comment |
|---|---|---|
| Combustible metals..... | 0 | |
| Low flash point liquids..... | 0 | |
| Explosive materials..... | 0 | |
| Phosphorus..... | | |
| Hydrides..... | 0 | |
| Biological etc. materials..... | 0 | |
| Biodegradable materials..... | 0 | |
| Putrescible wastes..... | 0 | |
| Non-putrescible wastes..... | NE | |

**WASTE STREAM 2D77/C Encapsulated Retrieved Miscellaneous Beta/Gamma Waste**

| | | |
|---|---|---|
| Corrosive materials..... | P | Alakine grout. |
| Pyrophoric materials..... | 0 | |
| Generating toxic gases..... | 0 | |
| Reacting with water..... | 0 | |
| Higher activity particles..... | P | Small fraction will be present. |
| Soluble solids as bulk chemical compounds..... | P | Soluble sodium and magnesium compounds. |

Hazardous substances / non hazardous pollutants: -

| | (%wt) | Type(s) and comment |
|---|---|---|
| Acrylamide..... | | |
| Benzene..... | 0 | |
| Chlorinated solvents..... | | |
| Formaldehyde..... | | |
| Organometallics..... | | |
| Phenol..... | 0 | |
| Styrene..... | | |
| Tri-butyl phosphate..... | 0 | |
| Other organophosphates..... | | |
| Vinyl chloride..... | 0 | |
| Arsenic..... | 0 | |
| Barium..... | | |
| Boron..... | 0 | |
| Boron (in Boral)..... | | |
| Boron (non-Boral)..... | | |
| Cadmium..... | 0 | |
| Caesium..... | | |
| Selenium..... | 0 | |
| Chromium..... | 0 | |
| Molybdenum..... | 0 | |
| Thallium..... | | |
| Tin..... | P | Trace from cement in grout. |
| Vanadium..... | 0 | |
| Mercury compounds..... | | |
| Others..... | NE | |
| Electronic Electrical Equipment (EEE) | | |
| EEE Type 1..... | | |
| EEE Type 2..... | | |
| EEE Type 3..... | | |
| EEE Type 4..... | | |
| EEE Type 5..... | | |

## WASTE STREAM 2D77/C Encapsulated Retrieved Miscellaneous Beta/Gamma Waste

Complexing agents (%wt): Not yet determined

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

Potential for the waste to contain discrete items: No.

### PACKAGING AND CONDITIONING

Container type:

| Container | Waste packaged (%vol) | Waste loading ($m^3$) | Payload ($m^3$) | Number of packages |
|---|---|---|---|---|
| 500 l drum | 100.0 | 0.5 | 0.5 | 1 |

Container type comment: -

Range in container waste volume: -

Other information on containers: 500 litre stainless steel drum.

Conditioned density ($t/m^3$): 2.6

Conditioned density comment: Density of conditioned waste. Raw waste density 1.6$t/m^3$.

Other information on conditioning: -

### RADIOACTIVITY

Source: Activity associated with waste, is from pond sludges and heavy metals that have contaminated and irradiated the material during long term storage.

Uncertainty: These specific activities are based on sampling results prior to trial drum being processed.

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: -

Other information: Nb 95 2.17E-05, Sr 89 1.12E-05, Zr95 2.17E-05.

## WASTE STREAM 2D77/C Encapsulated Retrieved Miscellaneous Beta/Gamma Waste

| Nuclide | Mean radioactivity, TBq/m³ Waste at 1.4.2022 | Bands and Code | Future arisings | Bands and Code | Nuclide | Mean radioactivity, TBq/m³ Waste at 1.4.2022 | Bands and Code | Future arisings | Bands and Code |
|---|---|---|---|---|---|---|---|---|---|
| H 3 | | | | | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | | | | | Ho 166m | | | | |
| Na 22 | | | | | Tm 170 | | | | |
| Al 26 | | | | | Tm 171 | | | | |
| Cl 36 | | | | | Lu 174 | | | | |
| Ar 39 | | | | | Lu 176 | | | | |
| Ar 42 | | | | | Hf 178n | | | | |
| K 40 | | | | | Hf 182 | | | | |
| Ca 41 | | | | | Pt 193 | | | | |
| Mn 53 | | | | | Tl 204 | | | | |
| Mn 54 | 1.68E-06 | B B 2 | | | Pb 205 | | | | |
| Fe 55 | | | | | Pb 210 | | | | |
| Co 60 | 1.24E-06 | B B 2 | | | Bi 208 | | | | |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | | | | | Po 210 | | | | |
| Zn 65 | | | | | Ra 223 | | | | |
| Se 79 | | | | | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | | | | |
| Kr 85 | | | | | Ra 228 | | | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | 2.88E-03 | B B 2 | | | Th 227 | | | | |
| Zr 93 | | | | | Th 228 | | | | |
| Nb 91 | | | | | Th 229 | | | | |
| Nb 92 | | | | | Th 230 | | | | |
| Nb 93m | | | | | Th 232 | | | | |
| Nb 94 | | | | | Th 234 | | | | |
| Mo 93 | | | | | Pa 231 | | | | |
| Tc 97 | | | | | Pa 233 | | | | |
| Tc 99 | | | | | U 232 | | | | |
| Ru 106 | 1.44E-06 | B B 2 | | | U 233 | | | | |
| Pd 107 | | | | | U 234 | 7.94E-09 | B B 2 | | |
| Ag 108m | | | | | U 235 | | | | |
| Ag 110m | | | | | U 236 | 1.58E-09 | B B 2 | | |
| Cd 109 | | | | | U 238 | 7.92E-09 | B B 2 | | |
| Cd 113m | | | | | Np 237 | | | | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | 1.19E-06 | B B 2 | | |
| Sn 123 | | | | | Pu 239 | 3.34E-06 | B B 2 | | |
| Sn 126 | | | | | Pu 240 | 3.59E-06 | B B 2 | | |
| Sb 125 | 9.83E-06 | B B 2 | | | Pu 241 | 6.89E-05 | B B 2 | | |
| Sb 126 | | | | | Pu 242 | 1.58E-09 | B B 2 | | |
| Te 125m | | | | | Am 241 | 7.53E-06 | B B 2 | | |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | | | Am 243 | | | | |
| Cs 134 | 3.98E-05 | B B 2 | | | Cm 242 | | | | |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | 1.09E-02 | B B 2 | | | Cm 244 | | | | |
| Ba 133 | | | | | Cm 245 | | | | |
| La 137 | | | | | Cm 246 | | | | |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | 4.60E-07 | B B 2 | | | Cf 249 | | | | |
| Pm 145 | | | | | Cf 250 | | | | |
| Pm 147 | | | | | Cf 251 | | | | |
| Sm 147 | | | | | Cf 252 | | | | |
| Sm 151 | | | | | Other a | | | | |
| Eu 152 | | | | | Other b/g | | | | |
| Eu 154 | 3.05E-05 | B B 2 | | | **Total a** | **1.57E-05** | **B B 2** | **0** | |
| Eu 155 | 2.31E-05 | B B 2 | | | **Total b/g** | **1.40E-02** | **B B 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