



**WASTE STREAM****2F01/C****Vitrified High Level Waste**

Th: Likely to be present as oxide.  
 U: Present as oxide.  
 Np: Likely to be present as oxide.  
 Pu: Present as oxide.

Metals and alloys (%wt): -

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

Organics (%wt): No organic materials are present.

|                                     | (%wt) | Type(s) and comment | % of total C14 activity |
|-------------------------------------|-------|---------------------|-------------------------|
| Total cellulose.....                |       |                     |                         |
| Paper, cotton.....                  |       |                     |                         |
| Wood.....                           |       |                     |                         |
| Halogenated plastics .....          |       |                     |                         |
| Total non-halogenated plastics..... |       |                     |                         |
| Condensation polymers.....          |       |                     |                         |
| Others.....                         |       |                     |                         |
| Organic ion exchange materials....  |       |                     |                         |
| Total rubber.....                   |       |                     |                         |
| 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): -

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|                                    | (%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     |                     |                         |
| Sand.....                          |       |                     |                         |
| Glass/Ceramics.....                | 100.0 |                     |                         |
| Graphite.....                      | 0     |                     |                         |
| Desiccants/Catalysts.....          |       |                     |                         |
| Asbestos.....                      | 0     |                     |                         |
| Non/low friable.....               | 0     |                     |                         |
| Moderately friable.....            | 0     |                     |                         |
| Highly friable.....                | 0     |                     |                         |
| Free aqueous liquids.....          | 0     |                     |                         |
| Free non-aqueous liquids.....      | 0     |                     |                         |
| Powder/Ash.....                    | 0     |                     |                         |

Inorganic anions (%wt):      Oxides are present.

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

Materials of interest for waste acceptance criteria:      There are no hazardous materials in the waste.

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

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Corrosive materials.....  
 Pyrophoric materials.....  
 Generating toxic gases.....  
 Reacting with water.....  
 Higher activity particles.....  
 Soluble solids as bulk chemical  
 compounds.....

Hazardous substances /            The waste contains toxic fission products.  
 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.....                            |       |  |
| Boron (in Boral).....                 |       |  |
| Boron (non-Boral).....                | P     | Boron Trioxide content within both types of glass<br>is within range 21-31 wt% |
| Cadmium.....                          |       |  |
| Caesium.....                          |       |  |
| Selenium.....                         |       |  |
| Chromium.....                         |       |  |
| Molybdenum.....                       |       |  |
| Thallium.....                         |       |  |
| Tin.....                              |       |  |
| Vanadium.....                         |       |  |
| Mercury compounds.....                |       |  |
| Others.....                           |       |  |
| Electronic Electrical Equipment (EEE) |       |  |
| EEE Type 1.....                       | 0     |  |
| EEE Type 2.....                       | 0     |  |
| EEE Type 3.....                       | 0     |  |
| EEE Type 4.....                       | 0     |  |
| EEE Type 5.....                       | 0     |  |

|                     |               |                                   |
|---------------------|---------------|-----------------------------------|
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|---------------------|---------------|-----------------------------------|

Complexing agents (%wt): No

(%wt) Type(s) and comment

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

Potential for the waste to contain discrete items: Yes. Entire waste stream is made up of discrete HLW containers.

**PACKAGING AND CONDITIONING**

| Container type: | Container    | Waste packaged (%vol) | Waste loading (m <sup>3</sup> ) | Payload (m <sup>3</sup> ) | Number of packages |
|-----------------|--------------|-----------------------|---------------------------------|---------------------------|--------------------|
|                 | HLW canister | 100.0                 | 0.15                            | 0.15                      | 3551               |

Container type comment: -

Range in container waste volume: -

Other information on containers: Stainless steel grade 309.

Conditioned density (t/m<sup>3</sup>): 2.65

Conditioned density comment: -

Other information on conditioning: This waste is already conditioned.

**RADIOACTIVITY**

Source: The main sources of activity in the waste are mixed fission products and actinides resulting from the reprocessing of irradiated Oxide and Magnox fuels.

Uncertainty: -

Definition of total alpha and total beta/gamma: The total alpha and beta/gamma activities are the sum of the reported nuclide activities only.

Measurement of radioactivities: The specific activity has been derived from plant records and predictions of feed stocks to the conditioning plant and a target waste incorporation of 25-28% in the conditioning matrix.

Other information: Short-lived daughters are not included. Other radionuclides not listed represent less than 0.01% of the total activity. The specific activity data for future arisings represent a simplification in that they are reported to be the same as current stocks. In general future arisings activity will be greater at the time of vitrification, but this will be offset somewhat by the longer post-reactor cooling times of future reprocessing waste. Any underestimation is adequately covered by the uncertainty factors given for volume arisings.

**WASTE STREAM**

**2F01/C**

**Vitrified High Level Waste**

| Nuclide | Mean radioactivity, TBq/m <sup>3</sup> |                |                 |                | Nuclide          | Mean radioactivity, TBq/m <sup>3</sup> |                |                 |                |
|---------|--|----------------|-----------------|----------------|------------------|--|----------------|-----------------|----------------|
|         | 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     |  | 8              |                 | 8              | Gd 153           | 1.41E-09                               | AA 2           | 1.41E-09        | BB 2           |
| Be 10   | 1.29E-04                               | AA 2           | 1.29E-04        | BB 2           | Ho 163           | 3.43E-08                               | AA 2           | 3.43E-08        | BB 2           |
| C 14    |  | 8              |                 | 8              | Ho 166m          | 1.95E-03                               | AA 2           | 1.95E-03        | BB 2           |
| Na 22   | NE                                     |                | NE              |                | Tm 170           | 6.33E-18                               | AA 2           | 6.33E-18        | BB 2           |
| Al 26   | NE                                     |                | NE              |                | Tm 171           | 4.48E-05                               | AA 2           | 4.48E-05        | BB 2           |
| Cl 36   |  | 8              |                 | 8              | Lu 174           | 1.22E-09                               | AA 2           | 1.22E-09        | BB 2           |
| Ar 39   |  | 8              |                 | 8              | Lu 176           | 9.17E-14                               | AA 2           | 9.17E-14        | BB 2           |
| Ar 42   |  | 8              |                 | 8              | Hf 178n          |  | 8              |                 | 8              |
| K 40    | 2.12E-08                               | AA 2           | 2.12E-08        | BB 2           | Hf 182           | 1.30E-12                               | AA 2           | 1.30E-12        | BB 2           |
| Ca 41   | 5.26E-04                               | AA 2           | 5.26E-04        | BB 2           | Pt 193           | 3.23E-08                               | AA 2           | 3.23E-08        | BB 2           |
| Mn 53   | 2.09E-10                               | AA 2           | 2.09E-10        | BB 2           | Tl 204           | 2.53E-09                               | AA 2           | 2.53E-09        | BB 2           |
| Mn 54   | 1.28E-07                               | AA 2           | 1.28E-07        | BB 2           | Pb 205           | 1.13E-09                               | AA 2           | 1.13E-09        | BB 2           |
| Fe 55   | 1.03E-01                               | AA 2           | 1.03E-01        | BB 2           | Pb 210           | 6.59E-07                               | AA 2           | 6.59E-07        | BB 2           |
| Co 60   | 3.21E+00                               | AA 2           | 3.21E+00        | BB 2           | Bi 208           | 2.24E-13                               | AA 2           | 2.24E-13        | BB 2           |
| Ni 59   | 5.91E-03                               | AA 2           | 5.91E-03        | BB 2           | Bi 210m          | 4.69E-14                               | AA 2           | 4.69E-14        | BB 2           |
| Ni 63   | 6.01E-01                               | AA 2           | 6.01E-01        | BB 2           | Po 210           | 6.39E-07                               | AA 2           | 6.39E-07        | BB 2           |
| Zn 65   | 1.15E-09                               | AA 2           | 1.15E-09        | BB 2           | Ra 223           | 1.04E-05                               | AA 2           | 1.04E-05        | BB 2           |
| Se 79   | 3.56E-02                               | AA 2           | 3.56E-02        | BB 2           | Ra 225           | 7.20E-08                               | AA 2           | 7.20E-08        | BB 2           |
| Kr 81   |  | 8              |                 | 8              | Ra 226           | 1.85E-06                               | AA 2           | 1.85E-06        | BB 2           |
| Kr 85   |  | 8              |                 | 8              | Ra 228           | 1.30E-10                               | AA 2           | 1.30E-10        | BB 2           |
| Rb 87   | 1.31E-05                               | AA 2           | 1.31E-05        | BB 2           | Ac 227           | 1.04E-05                               | AA 2           | 1.04E-05        | BB 2           |
| Sr 90   | 2.22E+04                               | AA 2           | 2.22E+04        | BB 2           | Th 227           | 1.03E-05                               | AA 2           | 1.03E-05        | BB 2           |
| Zr 93   | 1.12E+00                               | AA 2           | 1.12E+00        | BB 2           | Th 228           | 1.82E-04                               | AA 2           | 1.82E-04        | BB 2           |
| Nb 91   | 2.20E-07                               | AA 2           | 2.20E-07        | BB 2           | Th 229           | 7.21E-08                               | AA 2           | 7.21E-08        | BB 2           |
| Nb 92   | 1.71E-09                               | AA 2           | 1.71E-09        | BB 2           | Th 230           | 1.59E-04                               | AA 2           | 1.59E-04        | BB 2           |
| Nb 93m  | 8.41E-01                               | AA 2           | 8.41E-01        | BB 2           | Th 232           | 1.41E-10                               | AA 2           | 1.41E-10        | BB 2           |
| Nb 94   | 9.47E-05                               | AA 2           | 9.47E-05        | BB 2           | Th 234           | 4.83E-04                               | AA 2           | 4.83E-04        | BB 2           |
| Mo 93   | 7.03E-04                               | AA 2           | 7.03E-04        | BB 2           | Pa 231           | 1.72E-05                               | AA 2           | 1.72E-05        | BB 2           |
| Tc 97   | 9.16E-11                               | AA 2           | 9.16E-11        | BB 2           | Pa 233           | 1.11E-01                               | AA 2           | 1.11E-01        | BB 2           |
| Tc 99   | 7.15E+00                               | AA 2           | 7.15E+00        | BB 2           | U 232            | 1.69E-05                               | AA 2           | 1.69E-05        | BB 2           |
| Ru 106  | 4.19E-02                               | AA 2           | 4.19E-02        | BB 2           | U 233            | 8.13E-06                               | AA 2           | 8.13E-06        | BB 2           |
| Pd 107  | 5.95E-02                               | AA 2           | 5.95E-02        | BB 2           | U 234            | 1.84E-03                               | AA 2           | 1.84E-03        | BB 2           |
| Ag 108m | 1.17E-05                               | AA 2           | 1.17E-05        | BB 2           | U 235            | 2.62E-05                               | AA 2           | 2.62E-05        | BB 2           |
| Ag 110m | 3.22E-07                               | AA 2           | 3.22E-07        | BB 2           | U 236            | 3.41E-04                               | AA 2           | 3.41E-04        | BB 2           |
| Cd 109  | 5.79E-08                               | AA 2           | 5.79E-08        | BB 2           | U 238            | 4.83E-04                               | AA 2           | 4.83E-04        | BB 2           |
| Cd 113m | 4.01E+00                               | AA 2           | 4.01E+00        | BB 2           | Np 237           | 1.11E-01                               | AA 2           | 1.11E-01        | BB 2           |
| Sn 119m | 6.59E-08                               | AA 2           | 6.59E-08        | BB 2           | Pu 236           | 9.39E-07                               | AA 2           | 9.39E-07        | BB 2           |
| Sn 121m | 1.05E+01                               | AA 2           | 1.05E+01        | BB 2           | Pu 238           | 2.12E+00                               | AA 2           | 2.12E+00        | BB 2           |
| Sn 123  | 2.42E-14                               | AA 2           | 2.42E-14        | BB 2           | Pu 239           | 5.37E-01                               | AA 2           | 5.37E-01        | BB 2           |
| Sn 126  | 8.50E-02                               | AA 2           | 8.50E-02        | BB 2           | Pu 240           | 1.27E+00                               | AA 2           | 1.27E+00        | BB 2           |
| Sb 125  | 8.77E+00                               | AA 2           | 8.77E+00        | BB 2           | Pu 241           | 3.50E+01                               | AA 2           | 3.50E+01        | BB 2           |
| Sb 126  | 6.29E-02                               | AA 2           | 6.29E-02        | BB 2           | Pu 242           | 2.07E-03                               | AA 2           | 2.07E-03        | BB 2           |
| Te 125m | 2.14E+00                               | AA 2           | 2.14E+00        | BB 2           | Am 241           | 9.62E+02                               | AA 2           | 9.62E+02        | BB 2           |
| Te 127m | 2.65E-14                               | AA 2           | 2.65E-14        | BB 2           | Am 242m          | 2.08E+00                               | AA 2           | 2.08E+00        | BB 2           |
| I 129   |  | 8              |                 | 8              | Am 243           | 4.82E+00                               | AA 2           | 4.82E+00        | BB 2           |
| Cs 134  | 1.02E+01                               | AA 2           | 1.02E+01        | BB 2           | Cm 242           | 1.72E+00                               | AA 2           | 1.72E+00        | BB 2           |
| Cs 135  | 3.26E-01                               | AA 2           | 3.26E-01        | BB 2           | Cm 243           | 1.97E+00                               | AA 2           | 1.97E+00        | BB 2           |
| Cs 137  | 3.12E+04                               | AA 2           | 3.12E+04        | BB 2           | Cm 244           | 1.59E+02                               | AA 2           | 1.59E+02        | BB 2           |
| Ba 133  | 2.01E-05                               | AA 2           | 2.01E-05        | BB 2           | Cm 245           | 4.64E-02                               | AA 2           | 4.64E-02        | BB 2           |
| La 137  | 1.88E-06                               | AA 2           | 1.88E-06        | BB 2           | Cm 246           | 8.56E-03                               | AA 2           | 8.56E-03        | BB 2           |
| La 138  | 1.42E-10                               | AA 2           | 1.42E-10        | BB 2           | Cm 248           | 6.71E-08                               | AA 2           | 6.71E-08        | BB 2           |
| Ce 144  | 2.07E-03                               | AA 2           | 2.07E-03        | BB 2           | Cf 249           | 6.58E-07                               | AA 2           | 6.58E-07        | BB 2           |
| Pm 145  | 6.56E-05                               | AA 2           | 6.56E-05        | BB 2           | Cf 250           | 1.14E-06                               | AA 2           | 1.14E-06        | BB 2           |
| Pm 147  | 1.22E+02                               | AA 2           | 1.22E+02        | BB 2           | Cf 251           | 2.84E-08                               | AA 2           | 2.84E-08        | BB 2           |
| Sm 147  | 4.73E-06                               | AA 2           | 4.73E-06        | BB 2           | Cf 252           | 5.64E-09                               | AA 2           | 5.64E-09        | BB 2           |
| Sm 151  | 1.76E+02                               | AA 2           | 1.76E+02        | BB 2           | Other a          | NE                                     | 6              | NE              | 6              |
| Eu 152  | 8.81E-01                               | AA 2           | 8.81E-01        | BB 2           | Other b/g        | NE                                     | 6              | NE              | 6              |
| Eu 154  | 3.44E+02                               | AA 2           | 3.44E+02        | BB 2           | <b>Total a</b>   | <b>1.13E+03</b>                        | <b>AA 2</b>    | <b>1.13E+03</b> | <b>BB 2</b>    |
| Eu 155  | 2.66E+01                               | AA 2           | 2.66E+01        | BB 2           | <b>Total b/g</b> | <b>5.41E+04</b>                        | <b>AA 2</b>    | <b>5.41E+04</b> | <b>BB 2</b>    |

**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