

| WASTE STREAM | 2D200 | Contact Handled ILW from Harwell |
|--------------|-------|----------------------------------|
|--------------|-------|----------------------------------|

**SITE** Sellafield

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Sellafield Ltd

**WASTE TYPE** ILW

#### WASTE VOLUMES

|                        | Reported (m <sup>3</sup> ) | OR      | Conditioned (m <sup>3</sup> ) | Packaged (m <sup>3</sup> ) |
|------------------------|----------------------------|---------|-------------------------------|----------------------------|
| Stocks:                | At 1.4.2025                | = 722.0 |                               |                            |
| Future arisings:       |                            |         |                               |                            |
| Total future arisings: |                            | 0.0     |                               |                            |
| Total waste volume:    |                            | 722.0   |                               |                            |

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

Comment on arising rates: Future transfers are not quantified in this waste stream to avoid double counting as they are reported in waste stream 5C317

Additional information on quantities: The waste stream has a fixed inventory of 4,004 drums to be transferred to Sellafield

Uncertainty factors on volumes: Stock (upper): x 1.05 Arisings (upper): x -  
Stock (lower): x 0.95 Arisings (lower): x -

**WASTE SOURCE** The waste has originated from three sources; Harwell facility sources, Winfrith facility wastes and National Disposal services waste. The Harwell waste consists of solid operational waste from glovebox and alpha handling cell operations and also waste arising from the decommissioning of the cells, gloveboxes, ventilation system and pipework. The Winfrith waste has mostly arisen from the fast reactor oxide fuel manufacturing line and from the decommissioning of associated gloveboxes and facilities. The NDS waste has been produced by industry, research laboratories, educational establishments and hospitals.

#### PHYSICAL CHARACTERISTICS

General description: The waste consists of solid operational waste produced from Harwell glovebox and alpha-handling cell operations. It also includes waste arising from the decommissioning of gloveboxes and facilities. It also includes laboratory waste. Additionally there will be medical waste and sources.

Changes since waste generated: A portion of the drums have been repackaged since it was generated and the soft waste shredded before being repackaged again.

Bulk density (t/m<sup>3</sup>): = 0.64

Comment on density: Mass of waste divided by volume.

#### CHEMICAL COMPOSITION

General description and components (%wt): Metal (78.3%), Soil/Rubble (3.6%), Soft Organics (0.1%), Plastic/Rubber (8.9%), Paper/Wood (1.5%), Absorbed liquid (0.3%), Other (7.3%).

Chemical state: Neutral

Sheet metal proportion / thickness: Metal is present in a large range of thicknesses.

Metals and alloys (%wt):

|                           | (%wt)  | Type(s) / Grades(s) with proportions           | % of total C14 activity |
|---------------------------|--------|------------------------------------------------|-------------------------|
| Stainless steel.....      | = 33.0 | -                                              |                         |
| Other ferrous metals..... | = 13.0 | Includes mild steel                            |                         |
| Iron.....                 | < 0.50 | -                                              |                         |
| Aluminium.....            | = 7.0  | -                                              |                         |
| Beryllium.....            | TR     | -                                              |                         |
| Cobalt.....               | NE     | -                                              |                         |
| Copper.....               | = 3.0  | Copper (2.5%) Brass (0.4%)                     |                         |
| Lead.....                 | = 1.3  | -                                              |                         |
| Magnox/Magnesium.....     | TR     | -                                              |                         |
| Nickel.....               | TR     | -                                              |                         |
| Titanium.....             | TR     | -                                              |                         |
| Uranium.....              | TR     | -                                              |                         |
| Zinc.....                 | TR     | -                                              |                         |
| Zircaloy/Zirconium.....   | TR     | -                                              |                         |
| Other metals.....         | = 20.5 | Cadmium, Gold, Magnesium, Nickel, Silver, Tin. |                         |

Organics (%wt):

|                                     | (%wt)  | Type(s) and comment              | % of total C14 activity |
|-------------------------------------|--------|----------------------------------|-------------------------|
| Total cellulose.....                | = 1.5  | -                                |                         |
| Paper, cotton.....                  | = 1.1  | -                                |                         |
| Wood.....                           | = 0.40 | -                                |                         |
| Halogenated plastics.....           | = 6.8  | Contains PVC                     |                         |
| Total non-halogenated plastics..... | = 1.1  | Contains perspex and polystyrene |                         |
| Condensation polymers.....          | TR     | Contains nylon and bakelite      |                         |
| Others.....                         | = 1.1  | -                                |                         |
| Organic ion exchange materials..... | TR     | -                                |                         |
| Total rubber.....                   | = 1.0  | -                                |                         |
| Halogenated rubber.....             | = 1.0  | -                                |                         |
| Non-halogenated rubber.....         | TR     | -                                |                         |
| Hydrocarbons.....                   | < 1.0  | -                                |                         |
| Oil or grease.....                  | TR     | -                                |                         |
| Fuel.....                           | = 0    | -                                |                         |
| Asphalt/Tarmac (cont.coal tar)..... | = 0    | -                                |                         |
| Asphalt/Tarmac (no coal tar).....   | = 0    | -                                |                         |
| Bitumen.....                        | < 1.0  | -                                |                         |
| Others.....                         | = 0    | -                                |                         |
| Other organics.....                 | = 6.7  | -                                |                         |

Other materials (%wt):

|                                       | (%wt)  | Type(s) and comment             | % of total C14 activity |
|---------------------------------------|--------|---------------------------------|-------------------------|
| Inorganic ion exchange materials..... | TR     | -                               |                         |
| Inorganic sludges and flocs.....      | TR     | -                               |                         |
| Soil.....                             | TR     | -                               |                         |
| Brick/Stone/Rubble.....               | = 1.8  | -                               |                         |
| Cementitious material.....            | = 1.1  | -                               |                         |
| Sand.....                             | TR     | -                               |                         |
| Glass/Ceramics.....                   | = 0.70 | -                               |                         |
| Graphite.....                         | TR     | -                               |                         |
| Desiccants/Catalysts.....             |        | -                               |                         |
| Asbestos.....                         | TR     | -                               |                         |
| Non/low friable.....                  | NE     | -                               |                         |
| Moderately friable.....               | NE     | -                               |                         |
| Highly friable.....                   | NE     | -                               |                         |
| Free aqueous liquids.....             | TR     | -                               |                         |
| Free non-aqueous liquids.....         | TR     | -                               |                         |
| Powder/Ash.....                       | TR     | Trace amount of Eutectic powder |                         |

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

Inorganic anions (%wt):

|                | (%wt)  | Type(s) and comment |
|----------------|--------|---------------------|
| Fluoride.....  | TR     | -                   |
| Chloride.....  | TR     | -                   |
| Iodide.....    | TR     | -                   |
| Cyanide.....   | = 0    | -                   |
| Carbonate..... | = 0.20 | -                   |
| Nitrate.....   | P      | -                   |
| Nitrite.....   | TR     | -                   |
| Phosphate..... | TR     | -                   |
| Sulphate.....  | TR     | -                   |
| Sulphide.....  | TR     | -                   |

Materials of interest for waste acceptance criteria:

|                                                | (%wt) | Type(s) and comment   |
|------------------------------------------------|-------|-----------------------|
| Combustible metals.....                        | P     | -                     |
| Low flash point liquids.....                   | = 0   | -                     |
| Explosive materials.....                       | = 0   | -                     |
| Phosphorus.....                                | P     | Trace amounts present |
| Hydrides.....                                  | P     | Trace amounts present |
| Biological etc. materials.....                 | P     | Trace amounts present |
| Biodegradable materials.....                   | = 0   | -                     |
| Putrescible wastes.....                        |       | -                     |
| Non-putrescible wastes.....                    |       | -                     |
| Corrosive materials.....                       | P     | Trace amounts present |
| Pyrophoric materials.....                      | P     | Trace amounts present |
| Generating toxic gases.....                    | = 0   | -                     |
| Reacting with water.....                       | P     | Trace amounts present |
| Higher activity particles.....                 | P     | -                     |
| Soluble solids as bulk chemical compounds..... | NE    | -                     |

Hazardous substances / non hazardous pollutants:

|                             | (%wt) | Type(s) and comment |
|-----------------------------|-------|---------------------|
| Acrylamide.....             | NE    | -                   |
| Benzene.....                | NE    | -                   |
| Chlorinated solvents.....   | NE    | -                   |
| Formaldehyde.....           | NE    | -                   |
| Organometallics.....        | NE    | -                   |
| Phenol.....                 | NE    | -                   |
| Styrene.....                | NE    | -                   |
| Tri-butyl phosphate.....    | = 0   | -                   |
| Other organophosphates..... | NE    | -                   |
| Vinyl chloride.....         | P     | As PVC.             |
| Arsenic.....                | NE    | -                   |
| Barium.....                 | NE    | -                   |
| Boron.....                  | NE    | -                   |
| Boron (in Boral).....       | NE    | -                   |
| Boron (non-Boral).....      | NE    | -                   |
| Cadmium.....                | P     | -                   |
| Caesium.....                | NE    | -                   |
| Selenium.....               | NE    | -                   |
| Chromium.....               | P     | -                   |
| Molybdenum.....             | P     | -                   |
| Thallium.....               | NE    | -                   |
| Tin.....                    | P     | -                   |
| Vanadium.....               | P     | -                   |
| Mercury compounds.....      | NE    | -                   |
| Others.....                 | NE    | -                   |

Complexing agents (%wt):

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

Physical components:

|                                         | Number | Type(s) and comment                       |
|-----------------------------------------|--------|-------------------------------------------|
| Sources.....                            | > 100  | 151 - obtained from waste package records |
| Electronic & Electrical Equipment (EEE) |        |                                           |
| EEE Type 1.....                         | P      | -                                         |
| EEE Type 2.....                         | P      | -                                         |
| EEE Type 3.....                         | P      | -                                         |
| EEE Type 4.....                         | P      | -                                         |
| EEE Type 5.....                         | P      | -                                         |

## TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

| Treatment                                                  | On-site / Off-site | Stream volume % |
|------------------------------------------------------------|--------------------|-----------------|
| Size reduction                                             | On-site            | = 90.0          |
| Decay storage                                              |                    |                 |
| Low force compaction                                       |                    |                 |
| Supercompaction (HFC)                                      |                    |                 |
| Incineration                                               |                    |                 |
| Drying/dewatering/liquid separation                        | On-site            | = 10.0          |
| 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                                                       |                    |                 |

Comments on planned treatments:

Conditioning method:

At present there is no disposal route for the CHILW drums, however it is believed that with an extension to the current LOC a portion of this population could be processed through the Waste Treatment Complex (WTC). These drums could then be supercompacted in WTC and loaded into a basket within a 500 l drum such that there is a cement annulus between the basket and the drum skin. Future Waste Treatment Complex (WTC) facilities are currently projected to use a thermal treatment method.

Conditioning plants:

| Plant Name                       | Location   |
|----------------------------------|------------|
| Waste Treatment Complex 1 (WTC1) | Sellafield |

Likely conditioning matrix: Non-standard

Further information on the conditioning matrix: A GGBS/CEM I grout mix is used to generate the grout annulus which surrounds the compacted feed drums in a WTC product drum. The conditioning matrix relevant to future facilities (WTC2 and WTC3) is currently unknown.

#### Waste Packaging:

| Likely container type: | Container                     | Waste packaged (vol%) | Waste loading (m <sup>3</sup> ) | Payload (m <sup>3</sup> ) | Number of packages | Estimated start date for packaging |
|------------------------|-------------------------------|-----------------------|---------------------------------|---------------------------|--------------------|------------------------------------|
|                        | 500 l drum                    | 10.0                  | 0.20                            | 0.50                      | 361                | -                                  |
|                        | 500 l drum (basket for waste) | 90.0                  | 1.1                             | 0.50                      | 570                | 2028                               |

Range in container waste loading: The reported waste loading is for the current WTC (supercompaction) process. Typically between 1 and 10 compacted 200 litre drums will be loaded into a 500 litre drum, with an average of 5.7. We also assume that ~10% of CHILW drums may need direct grouting if they are not compactable.

Other information on packaging and conditioning: -

Conditioned density (t/m<sup>3</sup>): = 2.1  
Conditioned density comment: Conditioned density calculated using data from current WTC product drum stock. The density is typically between 1.8 and 2.6 t/m<sup>3</sup>, although values outside of this range are possible.

#### Management Routes:

| Disposal Route                                                                     | Stream volume % | Raw density t/m <sup>3</sup> | Start date |
|------------------------------------------------------------------------------------|-----------------|------------------------------|------------|
| Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland) | 100.0           |                              | 2050       |
| Expected to be Non-NSD HAW managed under Scottish Government's policy              |                 |                              |            |
| 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: Yes

| Baseline Management Route | Opportunity Management Route | Stream volume (%) | Opportunity Confidence | Comment                                                                                                                    |
|---------------------------|------------------------------|-------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------|
| GDF                       | GDF                          | -                 | RED                    | Potential for stream volume reduction if the treatment is deferred until the establishment of a thermal treatment facility |

#### RADIOACTIVITY

Source: The source of radioactivity is from glovebox and cell operations at Harwell, Winfrith site and NDS waste.

Uncertainty: The specific activity uncertainty is based on records of arisings.

Measurement of radioactivities: Specific activity data has been derived using measured activity and dividing by the measured waste volume.

Chemical form of radionuclides: H-3: May be present as gaseous sources.  
C-14: -  
Cl-36: -  
Se-79: -  
Tc-99: -  
I-129: -  
Ra: -  
Th: Present as metal or oxide  
U: Comprising mainly oxide and metal  
Np: -  
Pu: Comprising mainly oxide and metal

| WASTE STREAM |                            | 2D200             |                 | Contact Handled ILW from Harwell |           |                            |                   |                 |                   |
|--------------|----------------------------|-------------------|-----------------|----------------------------------|-----------|----------------------------|-------------------|-----------------|-------------------|
| Nuclide      | Mean radioactivity, TBq/m³ |                   |                 |                                  | Nuclide   | Mean radioactivity, TBq/m³ |                   |                 |                   |
|              | Waste at<br>1.4.2025       | Bands and<br>Code | Future Arisings | Bands and<br>Code                |           | Waste at<br>1.4.2025       | Bands and<br>Code | Future Arisings | Bands and<br>Code |
| H 3          | 2.77E-01                   | B B 2             |                 |                                  | Gd 153    |                            |                   |                 |                   |
| Be 10        | 1.41E-15                   | B B 2             |                 |                                  | Ho 163    |                            |                   |                 |                   |
| C 14         | 9.77E-06                   | B B 2             |                 |                                  | Ho 166m   |                            |                   |                 |                   |
| Na 22        | 5.63E-08                   | B B 2             |                 |                                  | Tm 170    |                            |                   |                 |                   |
| Al 26        |                            |                   |                 |                                  | Tm 171    |                            |                   |                 |                   |
| Cl 36        | 2.87E-07                   | B B 2             |                 |                                  | Lu 174    |                            |                   |                 |                   |
| Ar 39        |                            |                   |                 |                                  | Lu 176    |                            |                   |                 |                   |
| Ar 42        |                            |                   |                 |                                  | Hf 178n   |                            |                   |                 |                   |
| K 40         | 6.20E-12                   | B B 2             |                 |                                  | Hf 182    |                            |                   |                 |                   |
| Ca 41        |                            |                   |                 |                                  | Pt 193    |                            |                   |                 |                   |
| Mn 53        |                            |                   |                 |                                  | Tl 204    | 3.25E-07                   | B B 2             |                 |                   |
| Mn 54        | 4.53E-11                   | B B 2             |                 |                                  | Pb 205    |                            |                   |                 |                   |
| Fe 55        | 2.73E-05                   | B B 2             |                 |                                  | Pb 210    | 1.41E-05                   | B B 2             |                 |                   |
| Co 60        | 1.77E-05                   | B B 2             |                 |                                  | Bi 208    |                            |                   |                 |                   |
| Ni 59        |                            |                   |                 |                                  | Bi 210m   |                            |                   |                 |                   |
| Ni 63        | 9.36E-04                   | B B 2             |                 |                                  | Po 210    | 1.81E-06                   | B B 2             |                 |                   |
| Zn 65        |                            |                   |                 |                                  | Ra 223    |                            |                   |                 |                   |
| Se 79        | 3.80E-10                   | B B 2             |                 |                                  | Ra 225    |                            |                   |                 |                   |
| Kr 81        |                            |                   |                 |                                  | Ra 226    | 8.80E-05                   | B B 2             |                 |                   |
| Kr 85        | 4.48E-05                   | B B 2             |                 |                                  | Ra 228    | 5.06E-06                   | B B 2             |                 |                   |
| Rb 87        |                            |                   |                 |                                  | Ac 227    | 1.55E-05                   | B B 2             |                 |                   |
| Sr 90        | 4.60E-04                   | B B 2             |                 |                                  | Th 227    |                            |                   |                 |                   |
| Zr 93        | 4.83E-09                   | B B 2             |                 |                                  | Th 228    | 5.85E-06                   | B B 2             |                 |                   |
| Nb 91        |                            |                   |                 |                                  | Th 229    | 2.64E-07                   | B B 2             |                 |                   |
| Nb 92        |                            |                   |                 |                                  | Th 230    | 1.41E-05                   | B B 2             |                 |                   |
| Nb 93m       | 5.94E-11                   | B B 2             |                 |                                  | Th 232    | 5.13E-06                   | B B 2             |                 |                   |
| Nb 94        |                            |                   |                 |                                  | Th 234    |                            |                   |                 |                   |
| Mo 93        | 5.11E-06                   | B B 2             |                 |                                  | Pa 231    | 8.86E-05                   | B B 2             |                 |                   |
| Tc 97        |                            |                   |                 |                                  | Pa 233    |                            |                   |                 |                   |
| Tc 99        | 2.51E-05                   | B B 2             |                 |                                  | U 232     | 5.38E-07                   | B B 2             |                 |                   |
| Ru 106       | 7.44E-09                   | B B 2             |                 |                                  | U 233     | 2.31E-05                   | B B 2             |                 |                   |
| Pd 107       |                            |                   |                 |                                  | U 234     | 3.14E-05                   | B B 2             |                 |                   |
| Ag 108m      | 1.20E-13                   | B B 2             |                 |                                  | U 235     | 1.81E-06                   | B B 2             |                 |                   |
| Ag 110m      |                            |                   |                 |                                  | U 236     | 1.58E-07                   | B B 2             |                 |                   |
| Cd 109       | 4.46E-08                   | B B 2             |                 |                                  | U 238     | 4.57E-05                   | B B 2             |                 |                   |
| Cd 113m      |                            |                   |                 |                                  | Np 237    | 4.08E-05                   | B B 2             |                 |                   |
| Sn 119m      |                            |                   |                 |                                  | Pu 236    | 5.21E-07                   | B B 2             |                 |                   |
| Sn 121m      |                            |                   |                 |                                  | Pu 238    | 3.17E-02                   | B B 2             |                 |                   |
| Sn 123       |                            |                   |                 |                                  | Pu 239    | 2.02E-02                   | B B 2             |                 |                   |
| Sn 126       | 1.84E-11                   | B B 2             |                 |                                  | Pu 240    | 1.77E-02                   | B B 2             |                 |                   |
| Sb 125       | 1.02E-07                   | B B 2             |                 |                                  | Pu 241    | 7.54E-01                   | B B 2             |                 |                   |
| Sb 126       |                            |                   |                 |                                  | Pu 242    | 1.00E-05                   | B B 2             |                 |                   |
| Te 125m      |                            |                   |                 |                                  | Am 241    | 3.19E-02                   | B B 2             |                 |                   |
| Te 127m      |                            |                   |                 |                                  | Am 242m   |                            |                   |                 |                   |
| I 129        | 4.43E-10                   | B B 2             |                 |                                  | Am 243    | 1.93E-06                   | B B 2             |                 |                   |
| Cs 134       | 2.42E-05                   | B B 2             |                 |                                  | Cm 242    | 8.54E-12                   | B B 2             |                 |                   |
| Cs 135       | 3.10E-08                   | B B 2             |                 |                                  | Cm 243    | 8.77E-13                   | B B 2             |                 |                   |
| Cs 137       | 6.91E-04                   | B B 2             |                 |                                  | Cm 244    | 1.34E-04                   | B B 2             |                 |                   |
| Ba 133       | 3.85E-07                   | B B 2             |                 |                                  | Cm 245    | 1.15E-08                   | B B 2             |                 |                   |
| La 137       |                            |                   |                 |                                  | Cm 246    |                            |                   |                 |                   |
| La 138       |                            |                   |                 |                                  | Cm 248    | 2.88E-07                   | B B 2             |                 |                   |
| Ce 144       | 8.99E-09                   | B B 2             |                 |                                  | Cf 249    | 5.91E-07                   | B B 2             |                 |                   |
| Pm 145       |                            |                   |                 |                                  | Cf 250    |                            |                   |                 |                   |
| Pm 147       | 1.09E-04                   | B B 2             |                 |                                  | Cf 251    |                            |                   |                 |                   |
| Sm 147       |                            |                   |                 |                                  | Cf 252    | 1.94E-07                   | B B 2             |                 |                   |
| Sm 151       | 2.02E-06                   | B B 2             |                 |                                  | Unsp a    | 3.92E-10                   | B B 2             |                 |                   |
| Eu 152       | 9.40E-08                   | B B 2             |                 |                                  | Unsp b/g  | 6.13E-08                   | B B 2             |                 |                   |
| Eu 154       | 1.59E-06                   | B B 2             |                 |                                  | Total a   | 1.02E-01                   | *                 | 0               | *                 |
| Eu 155       | 2.66E-09                   | B B 2             |                 |                                  | Total b/g | 1.03E+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