

| WASTE STREAM | 5C322 | Land Remediation LLW |
|--------------|-------|----------------------|
|--------------|-------|----------------------|

**SITE** Harwell

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Nuclear Restoration Services Ltd (NRS)

**WASTE TYPE** LLW

#### WASTE VOLUMES

|                        | Reported (m <sup>3</sup> ) | OR   | Conditioned (m <sup>3</sup> ) | Packaged (m <sup>3</sup> ) |
|------------------------|----------------------------|------|-------------------------------|----------------------------|
| Stocks:                | At 1.4.2025                | = 0  |                               |                            |
| Future arisings:       | 1.4.2027 - 31.3.2053       | 25.0 |                               |                            |
| Total future arisings: |                            | 25.0 |                               |                            |
| Total waste volume:    |                            | 25.0 |                               |                            |

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

Comment on arising rates: LLW soil and rubble arising from Land remediation at Harwell. Excludes LETP land as this is captured under 5C323 and 5C324

Additional information on quantities: Volumes updated for 2016 RWI to reflect SMART Inventory Review. This waste was originally part of 5C300 but this has been split to reflect LLW quantities for Land Remediation

Uncertainty factors on volumes: Stock (upper): x - Arisings (upper): x 2.00  
Stock (lower): x - Arisings (lower): x 0.10

**WASTE SOURCE** -

#### PHYSICAL CHARACTERISTICS

General description: Predominantly soil. There should be no large items in this waste stream.

Changes since waste generated: Land and buildings on the Harwell site, contaminated as a result of past operations.

Bulk density (t/m<sup>3</sup>): ~ 1.4

Comment on density: Average density for soil.

#### CHEMICAL COMPOSITION

General description and components (%wt): Soil ~85%; concrete/rubble ~15%.

Chemical state: -

Sheet metal proportion / thickness: There should be no sheet metal or bulk metal items present in the waste stream.

Metals and alloys (%wt):

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

Organics (%wt):

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

Other materials (%wt):

|                                       | (%wt)  | Type(s) and comment | % of total C14 activity |
|---------------------------------------|--------|---------------------|-------------------------|
| Inorganic ion exchange materials..... | NE     | -                   |                         |
| Inorganic sludges and flocs.....      | NE     | -                   |                         |
| Soil.....                             | ~ 85.0 | -                   |                         |
| Brick/Stone/Rubble.....               | ~ 10.0 | -                   |                         |
| Cementitious material.....            | ~ 5.0  | -                   |                         |
| Sand.....                             |        | -                   |                         |
| Glass/Ceramics.....                   | NE     | -                   |                         |
| Graphite.....                         | NE     | -                   |                         |
| Desiccants/Catalysts.....             |        | -                   |                         |
| Asbestos.....                         | 0      | -                   |                         |
| Non/low friable.....                  |        | -                   |                         |
| Moderately friable.....               |        | -                   |                         |
| Highly friable.....                   |        | -                   |                         |
| Free aqueous liquids.....             |        | -                   |                         |
| Free non-aqueous liquids.....         |        | -                   |                         |
| Powder/Ash.....                       |        | -                   |                         |

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

Inorganic anions (%wt):

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

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:

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

Complexing agents (%wt):

| No                             |       |                     |
|--------------------------------|-------|---------------------|
|                                | (%wt) | Type(s) and comment |
| EDTA.....                      |       | -                   |
| DPTA.....                      |       | -                   |
| NTA.....                       |       | -                   |
| Polycarboxylic acids.....      |       | -                   |
| Other organic complexants..... |       | -                   |
| Total complexing agents.....   |       | -                   |

Physical components:

|                                         | Number | Type(s) and comment |
|-----------------------------------------|--------|---------------------|
| Sources.....                            |        | -                   |
| Electronic & Electrical Equipment (EEE) |        | -                   |
| EEE Type 1.....                         |        | -                   |
| EEE Type 2.....                         |        | -                   |
| EEE Type 3.....                         |        | -                   |
| EEE Type 4.....                         |        | -                   |
| EEE Type 5.....                         |        | -                   |

## TREATMENT, PACKAGING AND DISPOSAL

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

| Treatment                                                  | On-site / Off-site | Stream volume % |
|------------------------------------------------------------|--------------------|-----------------|
| Size reduction                                             |                    |                 |
| Decay storage                                              |                    |                 |
| Low force compaction                                       |                    |                 |
| Supercompaction (HFC)                                      |                    |                 |
| Incineration                                               |                    |                 |
| Drying/dewatering/liquid separation                        |                    |                 |
| 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                                                       |                    | = 100.0         |

Comments on planned treatments:

Waste will be disposed of to LLWR.

Conditioning method:

-

Conditioning plants:

| Plant Name | Location |
|------------|----------|
|            |          |

Likely conditioning matrix:

-

Further information on the conditioning matrix:

-

**Waste Packaging:**

| Likely container type: | Container                                          | Waste packaged (vol%) | Waste loading (m³) | Payload (m³) | Number of packages | Estimated start date for packaging |
|------------------------|----------------------------------------------------|-----------------------|--------------------|--------------|--------------------|------------------------------------|
|                        | 1/2 Height IP-2 Disposal/Re-usable ISO (TC01/TC02) | 100.0                 | 10.0               | 18.3         | 3                  | -                                  |

Range in container waste loading: -

Other information on packaging and conditioning: -

Conditioned density (t/m³): -  
Conditioned density comment: -**Management Routes:**

| Disposal Route                                                                     | Stream volume % | Raw density t/m³ | Start date |
|------------------------------------------------------------------------------------|-----------------|------------------|------------|
| Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland) | = 100.0         | 1.4              |            |
| 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: No

| Baseline Management Route | Opportunity Management Route | Stream volume (%) | Opportunity Confidence | Comment |
|---------------------------|------------------------------|-------------------|------------------------|---------|
| -                         | -                            | -                 | -                      | -       |

**RADIOACTIVITY**

Source: Contamination as a result of past operations.

Uncertainty: -

Measurement of radioactivities: Specific activity estimates are based on consignments from this stream in 2012. These are the best estimates currently, but some areas have yet to be characterised, and so values may change as more data becomes available.

Chemical form of radionuclides:  
H-3: -  
C-14: -  
Cl-36: -  
Se-79: -  
Tc-99: -  
I-129: -  
Ra: -  
Th: -  
U: -  
Np: -  
Pu: -

| WASTE STREAM 5C322 Land Remediation LLW |                            |                |                 |                |                  |                            |                |                 |                |
|-----------------------------------------|----------------------------|----------------|-----------------|----------------|------------------|----------------------------|----------------|-----------------|----------------|
| Nuclide                                 | Mean radioactivity, TBq/m³ |                |                 |                | Nuclide          | Mean radioactivity, TBq/m³ |                |                 |                |
|                                         | Waste at 1.4.2025          | Bands and Code | Future Arisings | Bands and Code |                  | Waste at 1.4.2025          | Bands and Code | Future Arisings | Bands and Code |
| H 3                                     |                            |                |                 | 8              | Gd 153           |                            |                |                 | 8              |
| Be 10                                   |                            |                |                 | 8              | Ho 163           |                            |                |                 | 8              |
| C 14                                    |                            |                |                 | 8              | Ho 166m          |                            |                |                 | 8              |
| Na 22                                   |                            |                |                 | 8              | Tm 170           |                            |                |                 | 8              |
| Al 26                                   |                            |                |                 | 8              | Tm 171           |                            |                |                 | 8              |
| Cl 36                                   |                            |                |                 | 8              | 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              | Ti 204           |                            |                |                 | 8              |
| Mn 54                                   |                            |                |                 | 8              | Pb 205           |                            |                |                 | 8              |
| Fe 55                                   |                            |                |                 | 8              | Pb 210           |                            |                | = 9.46E-09      | B B 2          |
| Co 60                                   |                            |                | = 3.13E-08      | B B 2          | Bi 208           |                            |                |                 | 8              |
| Ni 59                                   |                            |                |                 | 8              | Bi 210m          |                            |                |                 | 8              |
| Ni 63                                   |                            |                |                 | 8              | Po 210           |                            |                | = 9.16E-09      | B B 2          |
| Zn 65                                   |                            |                |                 | 8              | Ra 223           |                            |                | = 1.36E-09      | B B 2          |
| Se 79                                   |                            |                |                 | 8              | Ra 225           |                            |                |                 | 8              |
| Kr 81                                   |                            |                |                 | 8              | Ra 226           |                            |                | = 2.72E-08      | B B 2          |
| Kr 85                                   |                            |                |                 | 8              | Ra 228           |                            |                | = 1.85E-09      | B B 2          |
| Rb 87                                   |                            |                |                 | 8              | Ac 227           |                            |                | = 1.36E-09      | B B 2          |
| Sr 90                                   |                            |                |                 | 8              | Th 227           |                            |                | = 1.34E-09      | B B 2          |
| Zr 93                                   |                            |                |                 | 8              | Th 228           |                            |                | = 1.65E-09      | B B 2          |
| Nb 91                                   |                            |                |                 | 8              | Th 229           |                            |                |                 | 8              |
| Nb 92                                   |                            |                |                 | 8              | Th 230           |                            |                | = 2.72E-08      | B B 2          |
| Nb 93m                                  |                            |                |                 | 8              | Th 232           |                            |                | = 2.26E-09      | B B 2          |
| Nb 94                                   |                            |                |                 | 8              | Th 234           |                            |                | = 2.72E-08      | B B 2          |
| Mo 93                                   |                            |                |                 | 8              | Pa 231           |                            |                | = 1.36E-09      | B B 2          |
| Tc 97                                   |                            |                |                 | 8              | Pa 233           |                            |                |                 | 8              |
| Tc 99                                   |                            |                |                 | 8              | U 232            |                            |                |                 | 8              |
| Ru 106                                  |                            |                |                 | 8              | U 233            |                            |                |                 | 8              |
| Pd 107                                  |                            |                |                 | 8              | U 234            |                            |                | = 2.72E-08      | B B 2          |
| Ag 108m                                 |                            |                |                 | 8              | U 235            |                            |                | = 1.36E-09      | B B 2          |
| Ag 110m                                 |                            |                |                 | 8              | U 236            |                            |                |                 | 8              |
| Cd 109                                  |                            |                |                 | 8              | U 238            |                            |                | = 2.72E-08      | B B 2          |
| Cd 113m                                 |                            |                |                 | 8              | Np 237           |                            |                |                 | 8              |
| Sn 119m                                 |                            |                |                 | 8              | Pu 236           |                            |                |                 | 8              |
| Sn 121m                                 |                            |                |                 | 8              | Pu 238           |                            |                | = 1.40E-08      | B B 2          |
| Sn 123                                  |                            |                |                 | 8              | Pu 239           |                            |                | = 2.15E-07      | B B 2          |
| Sn 126                                  |                            |                |                 | 8              | Pu 240           |                            |                | = 2.15E-07      | B B 2          |
| Sb 125                                  |                            |                |                 | 8              | Pu 241           |                            |                | = 1.62E-07      | B B 2          |
| Sb 126                                  |                            |                |                 | 8              | Pu 242           |                            |                |                 | 8              |
| Te 125m                                 |                            |                |                 | 8              | Am 241           |                            |                | = 1.94E-07      | B B 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                                  |                            |                | = 1.67E-07      | B B 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              | Unsp a           |                            |                |                 |                |
| Eu 152                                  |                            |                |                 | 8              | Unsp b/g         |                            |                |                 |                |
| Eu 154                                  |                            |                |                 | 8              | <b>Total a</b>   | <b>0</b>                   | <b>*</b>       | <b>7.65E-07</b> | <b>*</b>       |
| Eu 155                                  |                            |                |                 | 8              | <b>Total b/g</b> | <b>0</b>                   | <b>*</b>       | <b>4.00E-07</b> | <b>*</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 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