

| WASTE STREAM | 9A313 | Stainless Steel (Reactor) LLW |
|--------------|-------|-------------------------------|
|--------------|-------|-------------------------------|

**SITE** Berkeley

**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:       | 1.4.2060 - 31.3.2079       | 6.6        |                               |                            |
| Total future arisings: |                            | <b>6.6</b> |                               |                            |
| Total waste volume:    |                            | <b>6.6</b> |                               |                            |

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

Comment on arising rates: For inventory purposes waste arisings are assumed to occur at a uniform rate over 20 years.

Additional information on quantities: Reactor Dismantling and Site Clearance is assumed to commence in 2060 and last for 20 years. The volumes and radioactivity have been calculated for 72 years after reactor shutdown i.e. 2060.

Uncertainty factors on volumes: Stock (upper): x - Arisings (upper): x 1.20  
Stock (lower): x - Arisings (lower): x 0.80

**WASTE SOURCE** Stainless steel items from reactor dismantling.

#### PHYSICAL CHARACTERISTICS

General description: A variety of stainless steel items including BSD piping and ducts.

Changes since waste generated: -

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

Comment on density: The density is of the waste as cut for packaging.

#### CHEMICAL COMPOSITION

General description and components (%wt): Stainless steels (100%).

Chemical state: Neutral

Sheet metal proportion / thickness: Items have been cut for packaging. Thicknesses are likely to vary from a few mm to about 25 mm.

Metals and alloys (%wt):

|                           | (%wt)   | Type(s) / Grades(s) with proportions                                      | % of total C14 activity |
|---------------------------|---------|---------------------------------------------------------------------------|-------------------------|
| Stainless steel.....      | = 100.0 | All of the waste included in this waste stream is stainless steel, EN58B. | 100.0                   |
| Other ferrous metals..... | = 0     | -                                                                         |                         |
| Iron.....                 |         | -                                                                         |                         |
| Aluminium.....            | = 0     | -                                                                         |                         |
| Beryllium.....            | 0       | -                                                                         |                         |
| Cobalt.....               |         | -                                                                         |                         |
| Copper.....               | = 0     | -                                                                         |                         |
| Lead.....                 | = 0     | -                                                                         |                         |
| Magnox/Magnesium.....     | = 0     | -                                                                         |                         |
| Nickel.....               |         | -                                                                         |                         |
| Titanium.....             |         | -                                                                         |                         |
| Uranium.....              |         | -                                                                         |                         |
| Zinc.....                 | = 0     | -                                                                         |                         |
| Zircaloy/Zirconium.....   | = 0     | -                                                                         |                         |
| Other metals.....         | = 0     | There are no "other" metals.                                              |                         |

Organics (%wt):

|                                     | (%wt) | Type(s) and comment | % of total C14 activity |
|-------------------------------------|-------|---------------------|-------------------------|
| Total cellulose.....                | = 0   | -                   |                         |
| Paper, cotton.....                  | = 0   | -                   |                         |
| Wood.....                           | = 0   | -                   |                         |
| Halogenated plastics.....           | = 0   | -                   |                         |
| Total non-halogenated plastics..... | = 0   | -                   |                         |
| Condensation polymers.....          | = 0   | -                   |                         |
| Others.....                         | = 0   | -                   |                         |
| Organic ion exchange materials..... | = 0   | -                   |                         |
| Total rubber.....                   | = 0   | -                   |                         |
| Halogenated rubber.....             | = 0   | -                   |                         |
| Non-halogenated rubber.....         | = 0   | -                   |                         |
| Hydrocarbons.....                   |       | -                   |                         |
| Oil or grease.....                  |       | -                   |                         |
| Fuel.....                           |       | -                   |                         |
| Asphalt/Tarmac (cont.coal tar)..... |       | -                   |                         |
| Asphalt/Tarmac (no coal tar).....   |       | -                   |                         |
| Bitumen.....                        |       | -                   |                         |
| Others.....                         |       | -                   |                         |
| Other organics.....                 | = 0   | -                   |                         |

Other materials (%wt):

|                                       | (%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.....                   | = 0   | -                   |                         |
| Graphite.....                         | TR    | -                   |                         |
| Desiccants/Catalysts.....             |       | -                   |                         |
| Asbestos.....                         | = 0   | -                   |                         |
| Non/low friable.....                  |       | -                   |                         |
| Moderately friable.....               |       | -                   |                         |
| Highly friable.....                   |       | -                   |                         |
| Free aqueous liquids.....             | = 0   | -                   |                         |
| Free non-aqueous liquids.....         | = 0   | -                   |                         |
| Powder/Ash.....                       | = 0   | -                   |                         |

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

Inorganic anions (%wt):

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

Materials of interest for waste acceptance criteria:

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

Hazardous substances / 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):

| Yes                            |       |                     |
|--------------------------------|-------|---------------------|
|                                | (%wt) | Type(s) and comment |
| EDTA.....                      | TR    | -                   |
| 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:

-

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         | 1                  | -                                  |

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              | 2060       |
| 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: Activation of the stainless steel and impurities. The activities quoted are those at 72 years after reactor shutdown, i.e. in 2060. There may be some contamination by Cs137.

Uncertainty: The values quoted were derived by calculation from available material specification and are indicative of the activities that are expected. The major source of uncertainty is the impurity levels.

Measurement of radioactivities: Specific Activities have been estimated using a neutron activation calculation.

Chemical form of radionuclides:

H-3: -

C-14: The carbon 14 is incorporated in the steel. There may also be some contamination as graphite.

Cl-36: The chlorine 36 is incorporated in the steel.

Se-79: -

Tc-99: -

I-129: -

Ra: -

Th: -

U: -

Np: -

Pu: -

| WASTE STREAM 9A313 Stainless Steel (Reactor) 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                                             |                            |                | 1.37E-05        | C C 2          | Ho 166m          |                            |                |                 | 8              |
| Na 22                                            |                            |                |                 | 8              | Tm 170           |                            |                |                 | 8              |
| Al 26                                            |                            |                |                 | 8              | Tm 171           |                            |                |                 | 8              |
| Cl 36                                            |                            |                | 1.46E-09        | C C 2          | Lu 174           |                            |                |                 | 8              |
| Ar 39                                            |                            |                |                 | 8              | Lu 176           |                            |                |                 | 8              |
| Ar 42                                            |                            |                |                 | 8              | Hf 178n          |                            |                |                 | 8              |
| K 40                                             |                            |                |                 | 8              | Hf 182           |                            |                |                 | 8              |
| Ca 41                                            |                            |                |                 | 8              | Pt 193           |                            |                |                 | 8              |
| Mn 53                                            |                            |                |                 | 8              | Tl 204           |                            |                | 1.04E-09        | C C 2          |
| Mn 54                                            |                            |                |                 | 8              | Pb 205           |                            |                |                 | 8              |
| Fe 55                                            |                            |                | 1.62E-09        | C C 2          | Pb 210           |                            |                |                 | 8              |
| Co 60                                            |                            |                | 1.97E-06        | C C 2          | Bi 208           |                            |                |                 | 8              |
| Ni 59                                            |                            |                | 3.55E-05        | C C 2          | Bi 210m          |                            |                |                 | 8              |
| Ni 63                                            |                            |                | 2.34E-03        | C C 2          | Po 210           |                            |                |                 | 8              |
| Zn 65                                            |                            |                |                 | 8              | Ra 223           |                            |                |                 | 8              |
| Se 79                                            |                            |                |                 | 8              | Ra 225           |                            |                |                 | 8              |
| Kr 81                                            |                            |                |                 | 8              | Ra 226           |                            |                |                 | 8              |
| Kr 85                                            |                            |                |                 | 8              | Ra 228           |                            |                |                 | 8              |
| Rb 87                                            |                            |                |                 | 8              | Ac 227           |                            |                |                 | 8              |
| Sr 90                                            |                            |                |                 | 8              | Th 227           |                            |                |                 | 8              |
| Zr 93                                            |                            |                |                 | 8              | Th 228           |                            |                |                 | 8              |
| Nb 91                                            |                            |                |                 | 8              | Th 229           |                            |                |                 | 8              |
| Nb 92                                            |                            |                |                 | 8              | Th 230           |                            |                |                 | 8              |
| Nb 93m                                           |                            |                |                 | 8              | Th 232           |                            |                |                 | 8              |
| Nb 94                                            |                            |                | 6.87E-08        | C C 2          | Th 234           |                            |                |                 | 8              |
| Mo 93                                            |                            |                | 4.55E-08        | C C 2          | Pa 231           |                            |                |                 | 8              |
| Tc 97                                            |                            |                |                 | 8              | Pa 233           |                            |                |                 | 8              |
| Tc 99                                            |                            |                | 9.81E-09        | C C 2          | U 232            |                            |                |                 | 8              |
| Ru 106                                           |                            |                |                 | 8              | U 233            |                            |                |                 | 8              |
| Pd 107                                           |                            |                |                 | 8              | U 234            |                            |                |                 | 8              |
| Ag 108m                                          |                            |                | 4.71E-09        | C C 2          | U 235            |                            |                |                 | 8              |
| Ag 110m                                          |                            |                |                 | 8              | U 236            |                            |                |                 | 8              |
| Cd 109                                           |                            |                |                 | 8              | U 238            |                            |                |                 | 8              |
| Cd 113m                                          |                            |                |                 | 8              | Np 237           |                            |                |                 | 8              |
| Sn 119m                                          |                            |                |                 | 8              | Pu 236           |                            |                |                 | 8              |
| Sn 121m                                          |                            |                |                 | 8              | Pu 238           |                            |                |                 | 8              |
| Sn 123                                           |                            |                |                 | 8              | Pu 239           |                            |                |                 | 8              |
| Sn 126                                           |                            |                |                 | 8              | Pu 240           |                            |                |                 | 8              |
| Sb 125                                           |                            |                |                 | 8              | Pu 241           |                            |                |                 | 8              |
| Sb 126                                           |                            |                |                 | 8              | Pu 242           |                            |                |                 | 8              |
| Te 125m                                          |                            |                |                 | 8              | Am 241           |                            |                |                 | 8              |
| 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                                           |                            |                |                 | 8              | 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>0</b>        | <b>*</b>       |
| Eu 155                                           |                            |                |                 | 8              | <b>Total b/g</b> | <b>0</b>                   | <b>*</b>       | <b>2.39E-03</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