

| WASTE STREAM | 9A78 | BPS Sludge in Drums |
|--------------|------|---------------------|
|--------------|------|---------------------|

**SITE** Berkeley

**SITE OWNER** Nuclear Decommissioning Authority

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

**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                | = 19.7 |                               |                            |
| Future arisings:       |                            |        |                               |                            |
| Total future arisings: |                            | 0.0    |                               |                            |
| Total waste volume:    |                            | 19.7   |                               |                            |

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

Comment on arising rates: -

Additional information on quantities: Station operation ceased in March 1989. This waste was accumulated between 1978 and 1983. Accumulation of sludge in drums ceased in 1983. The further operational sludge arisings are shown in waste stream 9A27. The volume split between this stream and stream 9A72 was revised prior to the 2004 Inventory in accordance with a Project Team judgement.

Uncertainty factors on volumes: Stock (upper): x 1.20 Arisings (upper): x -  
Stock (lower): x 0.90 Arisings (lower): x -

**WASTE SOURCE** The sludge originates from routine filtration of liquid effluents and cooling pond water.

#### PHYSICAL CHARACTERISTICS

General description: This waste arose from the routine filtration of liquid effluent and cooling pond water. The waste consists of corrosion products such as magnesium hydroxide and carbonate detached from fuel elements and extraneous materials such as flakes of paint. There will also be drain debris, asbestos fibre and other materials used as a precoat material. Some of the sludge drums will contain cotton socks, used for filtration purposes and PVC bags. This waste stream was originally classified as LLW, however it is not possible to distinguish between the caesium sludge (9A71 and 72) and this waste and so it will all be processed as ILW. The waste drums form part of 9A916 and will be processed as MCI waste. There are no large items that may require special handling. The sludge cans have approximate dimensions 890 mm long x 305 mm diameter.

Changes since waste generated: -

Bulk density (t/m<sup>3</sup>): ~ 1.1

Comment on density: -

#### CHEMICAL COMPOSITION

General description and components (%wt): The waste contains magnesium hydroxide, magnesium carbonate, water and a range of other materials, including ammonium molybdenum phosphate and potentially asbestos, which was used as a pre-coat. The solids content of the sludge is unknown as it varies from container to container. The slurry may vary from 'toothpaste' to water in constituency. Asbestos, cellulose and other precoat materials will probably account for <0.25wt%. The cotton socks and PVC bags will be removed and will form part of the BPS MCI waste stream (9A36-38). The waste can is included in waste stream 9A916.

Chemical state: Alkali

Sheet metal proportion / thickness: Any metal present is as finely divided material. There is no sheet or bulk metal.

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.....            | TR    | -                                                                                                            |                         |
| Cobalt.....               | -     | -                                                                                                            |                         |
| Copper.....               | NE    | -                                                                                                            |                         |
| Lead.....                 | TR    | -                                                                                                            |                         |
| Magnox/Magnesium.....     | TR    | Magnox will not be present except possibly in trace quantities.                                              |                         |
| Nickel.....               | -     | -                                                                                                            |                         |
| Titanium.....             | -     | -                                                                                                            |                         |
| Uranium.....              | -     | -                                                                                                            |                         |
| Zinc.....                 | NE    | -                                                                                                            |                         |
| Zircaloy/Zirconium.....   | NE    | -                                                                                                            |                         |
| Other metals.....         | NE    | The waste is contained within thick steel drums which when removed will form part of the 9A916 waste stream. |                         |

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    | The presence of halogenated plastics and rubbers has not been fully assessed. |                         |
| Condensation polymers.....          | NE    | -                                                                             |                         |
| Others.....                         | NE    | -                                                                             |                         |
| Organic ion exchange materials..... | NE    | -                                                                             |                         |
| Total rubber.....                   | NE    | The presence of halogenated plastics and rubbers has not been fully assessed. |                         |
| 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.....      | ~ 98.0 | -                   |                         |
| 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.....             | P      | -                   |                         |
| Free non-aqueous liquids.....         | NE     | -                   |                         |
| Powder/Ash.....                       | = 0    | -                   |                         |

#### 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.....   | = 0   | -                   |
| 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.....                        | TR    | -                   |
| Low flash point liquids.....                   | = 0   | -                   |
| Explosive materials.....                       | NE    | -                   |
| Phosphorus.....                                | = 0   | -                   |
| Hydrides.....                                  | = 0   | -                   |
| Biological etc. materials.....                 | TR    | -                   |
| Biodegradable materials.....                   | 0     | -                   |
| Putrescible wastes.....                        | = 0   | -                   |
| Non-putrescible wastes.....                    | -     | -                   |
| Corrosive materials.....                       | = 0   | -                   |
| Pyrophoric materials.....                      | = 0   | -                   |
| Generating toxic gases.....                    | NE    | -                   |
| Reacting with water.....                       | TR    | -                   |
| 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.....   | TR    | -                   |

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<br>Decay storage<br>Low force compaction<br>Supercompaction (HFC)<br>Incineration<br>Drying/dewatering/liquid separation<br>Tie down/fixatives/strippable coating/painting application<br>Decontamination<br>Metal treatment<br>Recycling / reuse<br>Thermal treatment, including vitrification<br>Encapsulation<br>Polymer encapsulation<br>Other physical treatment<br>Other chemical treatment<br>Containerisation<br>Treatment not yet determined<br>None |                    |                 |

Comments on planned treatments:

-

Conditioning method:

This stream is to be co-packaged with 9A37, 9A38, 9A57, 9A58, 9A59, 9A65, 9A68, 9A69, 9A70, 9A71, 9A75, 9A77, 9A82. Packages are assigned to 9A68, 9A71 & 9A75.

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

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) |                 |                  |            |
| 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: Sludge resulting from the treatment of pond and effluent waters and contaminated by fission products and activation products including actinides.

Uncertainty: Specific activity is a function of Station operating history. The values quoted are indicative of the activities that might be expected.

Measurement of radioactivities: -

Chemical form of radionuclides: H-3: Most tritium is expected to be present as water but some may be present in the form of other inorganic compounds or as organic compounds.  
C-14: Carbon 14 will probably be present as graphite.  
Cl-36: Chlorine 36 will probably be present as chloride.  
Se-79: The selenium content is insignificant.  
Tc-99: The technetium content is insignificant.  
I-129: -  
Ra: The radium isotope content is insignificant  
Th: The thorium isotope content is insignificant.  
U: Chemical form of U isotopes has not been determined but may be oxides.  
Np: The neptunium content is insignificant.  
Pu: Chemical form of Pu isotopes has not been determined but may be oxides.

| WASTE STREAM 9A78 BPS Sludge in Drums |                            |                |                 |                |                  |                            |                |                 |                |
|---------------------------------------|----------------------------|----------------|-----------------|----------------|------------------|----------------------------|----------------|-----------------|----------------|
| 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                                   | 7.85E-05                   | C D 3          |                 |                | Gd 153           |                            | 8              |                 |                |
| Be 10                                 |                            | 8              |                 |                | Ho 163           |                            | 8              |                 |                |
| C 14                                  | 4.60E-06                   | C D 3          |                 |                | Ho 166m          |                            | 8              |                 |                |
| Na 22                                 |                            | 8              |                 |                | Tm 170           |                            | 8              |                 |                |
| Al 26                                 |                            | 8              |                 |                | Tm 171           |                            | 8              |                 |                |
| Cl 36                                 | 1.80E-08                   | C D 3          |                 |                | Lu 174           |                            | 8              |                 |                |
| Ar 39                                 |                            | 8              |                 |                | Lu 176           |                            | 8              |                 |                |
| Ar 42                                 |                            | 8              |                 |                | Hf 178n          |                            | 8              |                 |                |
| K 40                                  |                            | 8              |                 |                | Hf 182           |                            | 8              |                 |                |
| Ca 41                                 | 2.70E-05                   | C D 3          |                 |                | Pt 193           |                            | 8              |                 |                |
| Mn 53                                 |                            | 8              |                 |                | Ti 204           |                            | 8              |                 |                |
| Mn 54                                 |                            | 8              |                 |                | Pb 205           |                            | 8              |                 |                |
| Fe 55                                 | 9.18E-08                   | C D 3          |                 |                | Pb 210           |                            | 8              |                 |                |
| Co 60                                 | 1.55E-05                   | C D 3          |                 |                | Bi 208           |                            | 8              |                 |                |
| Ni 59                                 | 5.50E-07                   | C D 3          |                 |                | Bi 210m          |                            | 8              |                 |                |
| Ni 63                                 | 5.66E-05                   | C D 3          |                 |                | Po 210           |                            | 8              |                 |                |
| Zn 65                                 |                            | 8              |                 |                | Ra 223           |                            | 8              |                 |                |
| Se 79                                 | 1.10E-07                   | C D 3          |                 |                | Ra 225           |                            | 8              |                 |                |
| Kr 81                                 |                            | 8              |                 |                | Ra 226           |                            | 8              |                 |                |
| Kr 85                                 |                            | 8              |                 |                | Ra 228           |                            | 8              |                 |                |
| Rb 87                                 |                            | 8              |                 |                | Ac 227           |                            | 8              |                 |                |
| Sr 90                                 | 1.21E-02                   | C D 3          |                 |                | Th 227           |                            | 8              |                 |                |
| Zr 93                                 | 6.30E-06                   | C D 3          |                 |                | Th 228           |                            | 8              |                 |                |
| Nb 91                                 |                            | 8              |                 |                | Th 229           |                            | 8              |                 |                |
| Nb 92                                 |                            | 8              |                 |                | Th 230           |                            | 8              |                 |                |
| Nb 93m                                | 1.80E-06                   | C D 3          |                 |                | Th 232           |                            | 8              |                 |                |
| Nb 94                                 |                            | 8              |                 |                | Th 234           | 6.40E-06                   | C D 3          |                 |                |
| Mo 93                                 |                            | 8              |                 |                | Pa 231           |                            | 8              |                 |                |
| Tc 97                                 |                            | 8              |                 |                | Pa 233           | 3.80E-05                   | C D 3          |                 |                |
| Tc 99                                 | 3.10E-05                   | C D 3          |                 |                | U 232            |                            | 8              |                 |                |
| Ru 106                                |                            | 8              |                 |                | U 233            |                            | 8              |                 |                |
| Pd 107                                |                            | 8              |                 |                | U 234            | 6.20E-06                   | C D 3          |                 |                |
| Ag 108m                               | 8.81E-08                   | C D 3          |                 |                | U 235            | 2.00E-07                   | C D 3          |                 |                |
| Ag 110m                               |                            | 8              |                 |                | U 236            | 1.30E-06                   | C D 3          |                 |                |
| Cd 109                                |                            | 8              |                 |                | U 238            | 6.40E-06                   | C D 3          |                 |                |
| Cd 113m                               |                            | 8              |                 |                | Np 237           | 3.80E-05                   | C D 3          |                 |                |
| Sn 119m                               |                            | 8              |                 |                | Pu 236           |                            | 8              |                 |                |
| Sn 121m                               |                            | 8              |                 |                | Pu 238           | 2.78E-04                   | C D 3          |                 |                |
| Sn 123                                |                            | 8              |                 |                | Pu 239           | 4.40E-04                   | C D 3          |                 |                |
| Sn 126                                | 5.40E-07                   | C D 3          |                 |                | Pu 240           | 6.30E-04                   | C D 3          |                 |                |
| Sb 125                                | 1.33E-08                   | C D 3          |                 |                | Pu 241           | 8.24E-03                   | C D 3          |                 |                |
| Sb 126                                | 7.56E-08                   | C D 3          |                 |                | Pu 242           | 5.00E-06                   | C D 3          |                 |                |
| Te 125m                               | 3.33E-09                   | C D 3          |                 |                | Am 241           | 2.77E-03                   | C D 3          |                 |                |
| Te 127m                               |                            | 8              |                 |                | Am 242m          | 2.91E-05                   | C D 3          |                 |                |
| I 129                                 | 6.30E-08                   | C D 3          |                 |                | Am 243           | 6.50E-06                   | C D 3          |                 |                |
| Cs 134                                |                            | 8              |                 |                | Cm 242           | 2.40E-05                   | C D 3          |                 |                |
| Cs 135                                | 3.80E-07                   | C D 3          |                 |                | Cm 243           | 2.87E-07                   | C D 3          |                 |                |
| Cs 137                                | 2.88E-02                   | C D 2          |                 |                | Cm 244           | 6.28E-06                   | C D 3          |                 |                |
| Ba 133                                |                            | 8              |                 |                | Cm 245           | 6.30E-07                   | C D 3          |                 |                |
| La 137                                |                            | 8              |                 |                | Cm 246           | 6.29E-07                   | C D 3          |                 |                |
| La 138                                |                            | 8              |                 |                | Cm 248           |                            | 8              |                 |                |
| Ce 144                                |                            | 8              |                 |                | Cf 249           |                            | 8              |                 |                |
| Pm 145                                |                            | 8              |                 |                | Cf 250           |                            | 8              |                 |                |
| Pm 147                                | 5.32E-06                   | C D 3          |                 |                | Cf 251           |                            | 8              |                 |                |
| Sm 147                                |                            | 8              |                 |                | Cf 252           |                            | 8              |                 |                |
| Sm 151                                | 2.77E-04                   | C D 3          |                 |                | Unsp a           |                            |                |                 |                |
| Eu 152                                | 7.35E-03                   | C D 3          |                 |                | Unsp b/g         |                            |                |                 |                |
| Eu 154                                | 2.90E-05                   | C D 3          |                 |                | <b>Total a</b>   | <b>4.21E-03</b>            | *              | <b>0</b>        | *              |
| Eu 155                                | 1.44E-06                   | C D 3          |                 |                | <b>Total b/g</b> | <b>5.71E-02</b>            | *              | <b>0</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