

| WASTE STREAM | 9J45 | Miscellaneous Activated Components R1 |
|--------------|------|---------------------------------------|
|--------------|------|---------------------------------------|

**SITE** Hunterston A

**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                | = 0.8 |                               |                            |
| Future arisings:       |                            |       |                               |                            |
| Total future arisings: |                            | 0.0   |                               |                            |
| Total waste volume:    |                            | 0.8   |                               |                            |

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

Comment on arising rates: -

Additional information on quantities: No future arisings.

Uncertainty factors on volumes:

|                |        |                   |     |
|----------------|--------|-------------------|-----|
| Stock (upper): | x 1.20 | Arisings (upper): | x - |
| Stock (lower): | x 0.80 | Arisings (lower): | x - |

**WASTE SOURCE** The source of the waste is in-core components.

#### PHYSICAL CHARACTERISTICS

General description: The waste consists of redundant control rods and associated equipment such as distance tubes. Control rods are approximately 200 kg each and are 7.08 m long (120 mm maximum diameter).

Changes since waste generated: -

Bulk density (t/m<sup>3</sup>): ~ 2.5

Comment on density: Bulk density is raw, as stored, and is estimated.

#### CHEMICAL COMPOSITION

General description and components (%wt): The waste consists principally of stainless steel, with other unspecified metals.

Chemical state: Neutral

Sheet metal proportion / thickness: Control rods (~100%). 7.06 m long x 0.12 m maximum diameter.

Metals and alloys (%wt):

|                           | (%wt)  | Type(s) / Grades(s) with proportions                                        | % of total C14 activity |
|---------------------------|--------|-----------------------------------------------------------------------------|-------------------------|
| Stainless steel.....      | ~ 90.0 | The waste contains steel and other metals.                                  |                         |
| Other ferrous metals..... | NE     | Control rods contain boron steel inserts.                                   |                         |
| Iron.....                 | -      | -                                                                           |                         |
| Aluminium.....            | NE     | -                                                                           |                         |
| Beryllium.....            | NE     | -                                                                           |                         |
| Cobalt.....               | -      | -                                                                           |                         |
| Copper.....               | NE     | -                                                                           |                         |
| Lead.....                 | NE     | -                                                                           |                         |
| Magnox/Magnesium.....     | TR     | -                                                                           |                         |
| Nickel.....               | NE     | Alloying proportions of tin, nickel, niobium and molybdenum may be present. |                         |
| Titanium.....             | -      | -                                                                           |                         |
| Uranium.....              | -      | -                                                                           |                         |
| Zinc.....                 | NE     | -                                                                           |                         |
| Zircaloy/Zirconium.....   | TR     | -                                                                           |                         |
| Other metals.....         | NE     | "Other" metals not fully assessed.                                          |                         |

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..... | NE    | -                   |                         |
| Condensation polymers.....          | NE    | -                   |                         |
| Others.....                         | NE    | -                   |                         |
| 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.....                         | NE    | -                   |                         |
| 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.....  | = 0   | -                   |
| 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):

| No                             |       |                     |
|--------------------------------|-------|---------------------|
|                                | (%wt) | Type(s) and comment |
| EDTA.....                      | = 0   | -                   |
| 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<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 | On-site            | 100.0           |

Comments on planned treatments:

-

Conditioning method:

The current proposal is to store the waste as at present until reactor dismantling. All waste is expected to be retrieved and conditioned when the conditioning campaign is undertaken. Baskets of different ILW wastes may be in the same package. The waste is not expected to be supercompacted. It will be placed in baskets in a 4m stainless steel ILW Box and is now assumed to be encapsulated.

Conditioning plants:

| Plant Name    | Location     |
|---------------|--------------|
| RDC Encap HNA | Hunterston A |

Likely conditioning matrix:

Unknown

Further information on the conditioning matrix:

The waste is assumed to be encapsulated. The matrix is likely to be BFS/OPC.

#### Waste Packaging:

| Likely container type: | Container                         | Waste packaged (vol%) | Waste loading (m³) | Payload (m³) | Number of packages | Estimated start date for packaging |
|------------------------|-----------------------------------|-----------------------|--------------------|--------------|--------------------|------------------------------------|
|                        | 4 m box (0 mm concrete shielding) | 100.0                 | 16.2               | 18.9         | 1                  | -                                  |

Range in container waste loading: This waste will only occupy one box.

Other information on packaging and conditioning:

Appropriate plant will be provided at the Station in accordance with Company strategy. Wastes will be in baskets placed in the waste packages. Baskets of different ILW wastes may be in the same packages. The matrix would be likely to be BFS/OPC. The density of the encapsulated waste would probably be about 3t/m3.

Conditioned density (t/m³):

~ 3.0

Conditioned density comment:

The density assumes that the waste is encapsulated.

#### 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) | NE              |                  |            |
| Expected to be Non-NSD HAW managed under Scottish Government's policy              | NE              |                  |            |
| 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 steel, principally due to Fe55 and Co60.

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: Estimates are based upon theoretical assessments.

Chemical form of radionuclides:

H-3: The chemical form of tritium has not been determined but may be present as water or as other inorganic compounds or as organic compounds.  
 C-14: Carbon 14 will be present as graphite.  
 Cl-36: The chemical form of chlorine 36 content has not been determined.  
 Se-79: The selenium content is insignificant.  
 Tc-99: The chemical form of technetium has not been determined.  
 I-129: -  
 Ra: The radium isotope content is insignificant.  
 Th: The thorium isotope content is insignificant.  
 U: The chemical form of uranium isotopes has not been determined but may be uranium oxides.  
 Np: The neptunium content is insignificant.  
 Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

| WASTE STREAM 9J45 Miscellaneous Activated Components R1 |                            |                |                 |                |                  |                            |                |                 |                |
|---------------------------------------------------------|----------------------------|----------------|-----------------|----------------|------------------|----------------------------|----------------|-----------------|----------------|
| 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                                                     | < 1.29E+00                 | C 2            |                 |                | Gd 153           |                            | 8              |                 |                |
| Be 10                                                   |                            | 8              |                 |                | Ho 163           |                            | 8              |                 |                |
| C 14                                                    | 2.00E-02                   | C C 2          |                 |                | Ho 166m          |                            | 8              |                 |                |
| Na 22                                                   |                            | 8              |                 |                | Tm 170           |                            | 8              |                 |                |
| Al 26                                                   |                            | 8              |                 |                | Tm 171           |                            | 8              |                 |                |
| Cl 36                                                   | 3.00E-05                   | 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              |                 |                | Ti 204           |                            | 8              |                 |                |
| Mn 54                                                   |                            | 8              |                 |                | Pb 205           |                            | 8              |                 |                |
| Fe 55                                                   | 4.42E-02                   | C C 2          |                 |                | Pb 210           |                            | 8              |                 |                |
| Co 60                                                   | 2.79E-01                   | C C 1          |                 |                | Bi 208           |                            | 8              |                 |                |
| Ni 59                                                   | 4.00E-02                   | C C 2          |                 |                | Bi 210m          |                            | 8              |                 |                |
| Ni 63                                                   | 2.70E+00                   | 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                                                   | < 3.50E-05                 | C 3            |                 |                | 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                                                   | 4.00E-05                   | C C 2          |                 |                | Th 234           | 7.00E-09                   | C C 2          |                 |                |
| Mo 93                                                   |                            | 8              |                 |                | Pa 231           |                            | 8              |                 |                |
| Tc 97                                                   |                            | 8              |                 |                | Pa 233           |                            | 8              |                 |                |
| Tc 99                                                   | < 1.00E-08                 | C 3            |                 |                | U 232            |                            | 8              |                 |                |
| Ru 106                                                  |                            | 8              |                 |                | U 233            |                            | 8              |                 |                |
| Pd 107                                                  |                            | 8              |                 |                | U 234            | < 6.12E-09                 | C 3            |                 |                |
| Ag 108m                                                 | 3.90E-05                   | C C 2          |                 |                | U 235            |                            | 8              |                 |                |
| Ag 110m                                                 |                            | 8              |                 |                | U 236            |                            | 8              |                 |                |
| Cd 109                                                  |                            | 8              |                 |                | U 238            | < 7.00E-09                 | C 3            |                 |                |
| Cd 113m                                                 |                            | 8              |                 |                | Np 237           |                            | 8              |                 |                |
| Sn 119m                                                 |                            | 8              |                 |                | Pu 236           |                            | 8              |                 |                |
| Sn 121m                                                 |                            | 8              |                 |                | Pu 238           | < 2.66E-06                 | C 3            |                 |                |
| Sn 123                                                  |                            | 8              |                 |                | Pu 239           | < 3.00E-06                 | C 3            |                 |                |
| Sn 126                                                  |                            | 8              |                 |                | Pu 240           | < 4.00E-06                 | C 3            |                 |                |
| Sb 125                                                  |                            | 8              |                 |                | Pu 241           | < 2.91E-05                 | C 3            |                 |                |
| Sb 126                                                  |                            | 8              |                 |                | Pu 242           | < 2.00E-09                 | C 3            |                 |                |
| Te 125m                                                 |                            | 8              |                 |                | Am 241           | < 8.82E-06                 | C 3            |                 |                |
| Te 127m                                                 |                            | 8              |                 |                | Am 242m          | < 1.86E-08                 | C 3            |                 |                |
| I 129                                                   |                            | 8              |                 |                | Am 243           | < 5.99E-09                 | C 3            |                 |                |
| Cs 134                                                  |                            | 8              |                 |                | Cm 242           | < 1.53E-08                 | C 3            |                 |                |
| Cs 135                                                  |                            | 8              |                 |                | Cm 243           | < 3.54E-09                 | C 3            |                 |                |
| Cs 137                                                  | < 4.96E-05                 | C 3            |                 |                | Cm 244           | < 3.38E-08                 | C 3            |                 |                |
| 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                                                  | < 1.71E-09                 | C 3            |                 |                | Cf 251           |                            | 8              |                 |                |
| Sm 147                                                  |                            | 8              |                 |                | Cf 252           |                            | 8              |                 |                |
| Sm 151                                                  | < 8.02E-07                 | C 3            |                 |                | Unsp a           |                            | 8              |                 |                |
| Eu 152                                                  | 9.27E-06                   | C C 2          |                 |                | Unsp b/g         |                            | 8              |                 |                |
| Eu 154                                                  | 5.95E-06                   | C C 2          |                 |                | <b>Total a</b>   | <b>1.86E-05</b>            | *              | <b>0</b>        | *              |
| Eu 155                                                  |                            | 8              |                 |                | <b>Total b/g</b> | <b>4.38E+00</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