

| WASTE STREAM | 9J59 | Ion Siv Cartridges |
|--------------|------|--------------------|
|--------------|------|--------------------|

**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                | = 0.1 |                               |                            |
| Future arisings:       | 1.4.2025 - 31.3.2026       | 0.1   |                               |                            |
| Total future arisings: |                            | 0.1   |                               |                            |
| Total waste volume:    |                            | 0.2   |                               |                            |

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

Comment on arising rates: -

Additional information on quantities: The MAETP plant was commissioned in 2009. The station ceased generation on 31/03/1990, with defuelling completed on 08/02/1995. The volume of each cartridge is 0.044 m<sup>3</sup>.

Uncertainty factors on volumes:

|                |        |                   |        |
|----------------|--------|-------------------|--------|
| Stock (upper): | x 1.20 | Arisings (upper): | x 1.50 |
| Stock (lower): | x 0.80 | Arisings (lower): | x 0.80 |

**WASTE SOURCE** Filtration of cartridge cooling pond water.

#### PHYSICAL CHARACTERISTICS

General description: Spent IONSIV cartridge that forms part of the Modular Active Effluent Treatment Plant. The size of the cartridge will not influence the choice of treatment process or disposal container.

Changes since waste generated: -

Bulk density (t/m<sup>3</sup>): ~ 1.2

Comment on density: The density of 1.2 t/m<sup>3</sup> assumes that each cartridge will contain 10 kg of water, giving a total mass of 66.2 kg for each cartridge.

#### CHEMICAL COMPOSITION

General description and components (%wt): The waste spent IONSIV cartridges, which are composed principally of a stainless steel hollow cylinder containing IONSIV material. IONSIV ion exchange material (~53%), stainless steel (~32%), water (~15%) and EPDM seal material (<1%). IONSIV is a crystalline silicotitanate. (EPDM is ethylene diene terpolymer).

Chemical state: Neutral

Sheet metal proportion / thickness: The stainless steel forms a hollow cylinder with dimensions: internal diameter 122mm, external diameter 296mm and height 640mm.

Metals and alloys (%wt):

|                           | (%wt)  | Type(s) / Grades(s) with proportions                                                                                    | % of total C14 activity |
|---------------------------|--------|-------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Stainless steel.....      | ~ 32.0 | The stainless steel is SS316L; nickel and chromium will be major constituents of the stainless steel cartridge housing. |                         |
| Other ferrous metals..... | NE     | -                                                                                                                       |                         |
| Iron.....                 |        | -                                                                                                                       |                         |
| Aluminium.....            | NE     | -                                                                                                                       |                         |
| Beryllium.....            | TR     | -                                                                                                                       |                         |
| Cobalt.....               |        | -                                                                                                                       |                         |
| Copper.....               | NE     | -                                                                                                                       |                         |
| Lead.....                 | NE     | -                                                                                                                       |                         |
| Magnox/Magnesium.....     | NE     | -                                                                                                                       |                         |
| Nickel.....               |        | -                                                                                                                       |                         |
| Titanium.....             |        | -                                                                                                                       |                         |
| Uranium.....              | NE     | -                                                                                                                       |                         |
| Zinc.....                 | NE     | -                                                                                                                       |                         |
| Zircaloy/Zirconium.....   | NE     | -                                                                                                                       |                         |
| Other metals.....         | NE     | Only the stainless steel content of the waste has been 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... | = 0   | -                                                       |                         |
| Condensation polymers...          | = 0   | -                                                       |                         |
| Others...                         | = 0   | -                                                       |                         |
| Organic ion exchange materials... | = 0   | -                                                       |                         |
| Total rubber...                   | < 1.0 | -                                                       |                         |
| Halogenated rubber...             | = 0   | -                                                       |                         |
| Non-halogenated rubber...         | < 1.0 | EPDM seal material (EPDM is ethylene diene terpolymer). |                         |
| 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... | ~ 53.0 | IONSIV material (crystalline silicotitanate) |                         |
| Inorganic sludges and flocs...      | = 0    | -                                            |                         |
| Soil...                             | = 0    | -                                            |                         |
| Brick/Stone/Rubble...               | = 0    | -                                            |                         |
| Cementitious material...            | = 0    | -                                            |                         |
| Sand...                             | -      | -                                            |                         |
| Glass/Ceramics...                   | = 0    | -                                            |                         |
| Graphite...                         | = 0    | -                                            |                         |
| Desiccants/Catalysts...             | -      | -                                            |                         |
| Asbestos...                         | = 0    | -                                            |                         |
| Non/low friable...                  | -      | -                                            |                         |
| Moderately friable...               | -      | -                                            |                         |
| Highly friable...                   | -      | -                                            |                         |
| Free aqueous liquids...             | ~ 15.0 | -                                            |                         |
| 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...  | NE    | -                   |
| Chloride...  | NE    | -                   |
| Iodide...    | NE    | -                   |
| Cyanide...   | NE    | -                   |
| Carbonate... | NE    | -                   |
| Nitrate...   | NE    | -                   |
| Nitrite...   | NE    | -                   |
| Phosphate... | NE    | -                   |
| Sulphate...  | NE    | -                   |
| Sulphide...  | NE    | -                   |

Materials of interest for waste acceptance criteria:

|                                              | (%wt) | Type(s) and comment |
|----------------------------------------------|-------|---------------------|
| Combustible metals...                        | = 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<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:

It is assumed that 1 cartridge will be packaged into each drum, each drum will then be placed into a 3m3 box. The waste is expected to be conditioned in a cast iron drum. The drummed waste will be over packed in a 3m3 box. A strategy decision needs to be taken as to whether the 3m3 box will be grouted.

Conditioning plants:

| Plant Name | Location     |
|------------|--------------|
| HNA SILWE  | Hunterston A |

Likely conditioning matrix:

Polymer

Further information on the conditioning matrix:

Work is in progress to determine the most appropriate matrix. Currently a polymer conditioning matrix is anticipated.

#### Waste Packaging:

| Likely container type: | Container               | Waste packaged (vol%) | Waste loading (m³) | Payload (m³) | Number of packages | Estimated start date for packaging |
|------------------------|-------------------------|-----------------------|--------------------|--------------|--------------------|------------------------------------|
|                        | 3 m³ box (side lifting) | 100.0                 | 0.04               | 2.9          | 4                  | -                                  |

Range in container waste loading: No significant variability is expected.

Other information on packaging and conditioning: The drum is cast iron and the 3m box is stainless steel. It is expected that a purpose-built cast iron drum with a 205 mm wall thickness will be used. One cartridge will be packaged into one drum.

Conditioned density (t/m³):  
Conditioned density comment:

NE  
Conditioned density is not estimated.

#### 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: A spent cartridge from the Modular Active Effluent Treatment Plant (MAETP), used for the removal of caesium isotopes from Cartridge Cooling Pond water. Contamination by fission products, actinides and activation products.

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: The activities were estimated from the fingerprint for the Cartridge Cooling Pond water sludge from waste stream 9J951 with a total activity of 0.6 TBq for the Cartridge Cooling Pond water.

Chemical form of radionuclides:

H-3: Any tritium is likely to be present as water.  
C-14: The carbon 14 content is insignificant.  
Cl-36: The chlorine 36 content is insignificant.  
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: The uranium isotope content is insignificant.  
Np: The neptunium content is insignificant.  
Pu: The chemical form of plutonium isotopes may be plutonium oxides.

| WASTE STREAM |                            | 9J59              |                 | Ion Siv Cartridges |           |                            |                   |                 |                   |
|--------------|----------------------------|-------------------|-----------------|--------------------|-----------|----------------------------|-------------------|-----------------|-------------------|
| Nuclide      | Mean radioactivity, TBq/m³ |                   |                 |                    | Nuclide   | Mean radioactivity, TBq/m³ |                   |                 |                   |
|              | Waste at<br>1.4.2025       | Bands and<br>Code | Future Arisings | Bands and<br>Code  |           | Waste at<br>1.4.2025       | Bands and<br>Code | Future Arisings | Bands and<br>Code |
| H 3          |                            | 8                 |                 | 8                  | Gd 153    |                            | 8                 |                 | 8                 |
| Be 10        |                            | 8                 |                 | 8                  | Ho 163    |                            | 8                 |                 | 8                 |
| C 14         |                            | 8                 |                 | 8                  | Ho 166m   |                            | 8                 |                 | 8                 |
| Na 22        |                            | 8                 |                 | 8                  | Tm 170    |                            | 8                 |                 | 8                 |
| Al 26        |                            | 8                 |                 | 8                  | Tm 171    |                            | 8                 |                 | 8                 |
| Cl 36        |                            | 8                 |                 | 8                  | Lu 174    |                            | 8                 |                 | 8                 |
| Ar 39        |                            | 8                 |                 | 8                  | Lu 176    |                            | 8                 |                 | 8                 |
| Ar 42        |                            | 8                 |                 | 8                  | Hf 178n   |                            | 8                 |                 | 8                 |
| K 40         |                            | 8                 |                 | 8                  | Hf 182    |                            | 8                 |                 | 8                 |
| Ca 41        |                            | 8                 |                 | 8                  | Pt 193    |                            | 8                 |                 | 8                 |
| Mn 53        |                            | 8                 |                 | 8                  | Tl 204    |                            | 8                 |                 | 8                 |
| Mn 54        |                            | 8                 |                 | 8                  | Pb 205    |                            | 8                 |                 | 8                 |
| Fe 55        | 1.59E-02                   | C C 2             | 1.59E-02        | C C 2              | Pb 210    |                            | 8                 |                 | 8                 |
| Co 60        | 1.88E-03                   | C C 2             | 1.88E-03        | C C 2              | Bi 208    |                            | 8                 |                 | 8                 |
| Ni 59        |                            | 8                 |                 | 8                  | Bi 210m   |                            | 8                 |                 | 8                 |
| Ni 63        |                            | 8                 |                 | 8                  | Po 210    |                            | 8                 |                 | 8                 |
| Zn 65        |                            | 8                 |                 | 8                  | Ra 223    |                            | 8                 |                 | 8                 |
| Se 79        |                            | 8                 |                 | 8                  | Ra 225    |                            | 8                 |                 | 8                 |
| Kr 81        |                            | 8                 |                 | 8                  | Ra 226    |                            | 8                 |                 | 8                 |
| Kr 85        |                            | 8                 |                 | 8                  | Ra 228    |                            | 8                 |                 | 8                 |
| Rb 87        |                            | 8                 |                 | 8                  | Ac 227    |                            | 8                 |                 | 8                 |
| Sr 90        | 7.87E-02                   | C C 2             | 7.87E-02        | C C 2              | Th 227    |                            | 8                 |                 | 8                 |
| Zr 93        |                            | 8                 |                 | 8                  | Th 228    |                            | 8                 |                 | 8                 |
| Nb 91        |                            | 8                 |                 | 8                  | Th 229    |                            | 8                 |                 | 8                 |
| Nb 92        |                            | 8                 |                 | 8                  | Th 230    |                            | 8                 |                 | 8                 |
| Nb 93m       |                            | 8                 |                 | 8                  | Th 232    |                            | 8                 |                 | 8                 |
| Nb 94        |                            | 8                 |                 | 8                  | Th 234    |                            | 8                 |                 | 8                 |
| Mo 93        |                            | 8                 |                 | 8                  | Pa 231    |                            | 8                 |                 | 8                 |
| Tc 97        |                            | 8                 |                 | 8                  | Pa 233    | 7.45E-08                   | C C 2             | 7.45E-08        | C C 2             |
| Tc 99        |                            | 8                 |                 | 8                  | U 232     |                            | 8                 |                 | 8                 |
| Ru 106       |                            | 8                 |                 | 8                  | U 233     |                            | 8                 |                 | 8                 |
| Pd 107       |                            | 8                 |                 | 8                  | U 234     | 2.71E-07                   | C C 2             | 2.71E-07        | C C 2             |
| Ag 108m      |                            | 8                 |                 | 8                  | U 235     |                            | 8                 |                 | 8                 |
| Ag 110m      |                            | 8                 |                 | 8                  | U 236     | 5.92E-09                   | C C 2             | 5.92E-09        | C C 2             |
| Cd 109       |                            | 8                 |                 | 8                  | U 238     |                            | 8                 |                 | 8                 |
| Cd 113m      |                            | 8                 |                 | 8                  | Np 237    | 7.54E-08                   | C C 2             | 7.54E-08        | C C 2             |
| Sn 119m      |                            | 8                 |                 | 8                  | Pu 236    |                            | 8                 |                 | 8                 |
| Sn 121m      |                            | 8                 |                 | 8                  | Pu 238    | 9.24E-03                   | C C 2             | 9.24E-03        | C C 2             |
| Sn 123       |                            | 8                 |                 | 8                  | Pu 239    | 2.00E-02                   | C C 2             | 2.00E-02        | C C 2             |
| Sn 126       |                            | 8                 |                 | 8                  | Pu 240    | 2.00E-02                   | C C 2             | 2.00E-02        | C C 2             |
| Sb 125       | 1.62E-05                   | C C 2             | 1.62E-05        | C C 2              | Pu 241    | 3.09E-01                   | C C 2             | 3.09E-01        | C C 2             |
| Sb 126       |                            | 8                 |                 | 8                  | Pu 242    |                            | 8                 |                 | 8                 |
| Te 125m      | < 4.06E-06                 | C 3               | < 4.06E-06      | C 3                | Am 241    | 2.60E-02                   | C C 2             | 2.60E-02        | C C 2             |
| Te 127m      |                            | 8                 |                 | 8                  | Am 242m   |                            | 8                 |                 | 8                 |
| I 129        |                            | 8                 |                 | 8                  | Am 243    | 2.02E-09                   | C C 2             | 2.02E-09        | C C 2             |
| Cs 134       | 1.74E-05                   | C C 2             | 1.74E-05        | C C 2              | Cm 242    |                            | 8                 |                 | 8                 |
| Cs 135       |                            | 8                 |                 | 8                  | Cm 243    | 7.94E-04                   | C C 2             | 7.94E-04        | C C 2             |
| Cs 137       | 1.59E+00                   | C C 2             | 1.59E+00        | C C 2              | Cm 244    | 6.82E-04                   | C C 2             | 6.82E-04        | C C 2             |
| Ba 133       |                            | 8                 |                 | 8                  | Cm 245    |                            | 8                 |                 | 8                 |
| La 137       |                            | 8                 |                 | 8                  | Cm 246    |                            | 8                 |                 | 8                 |
| La 138       |                            | 8                 |                 | 8                  | Cm 248    |                            | 8                 |                 | 8                 |
| Ce 144       |                            | 8                 |                 | 8                  | Cf 249    |                            | 8                 |                 | 8                 |
| Pm 145       |                            | 8                 |                 | 8                  | Cf 250    |                            | 8                 |                 | 8                 |
| Pm 147       |                            | 8                 |                 | 8                  | Cf 251    |                            | 8                 |                 | 8                 |
| Sm 147       |                            | 8                 |                 | 8                  | Cf 252    |                            | 8                 |                 | 8                 |
| Sm 151       |                            | 8                 |                 | 8                  | Unsp a    |                            | 8                 |                 | 8                 |
| Eu 152       |                            | 8                 |                 | 8                  | Unsp b/g  |                            | 8                 |                 | 8                 |
| Eu 154       | 2.23E-03                   | C C 2             | 2.23E-03        | C C 2              | Total a   | 7.67E-02                   | *                 | 7.67E-02        | *                 |
| Eu 155       | 4.79E-04                   | C C 2             | 4.79E-04        | C C 2              | Total b/g | 2.00E+00                   | *                 | 2.00E+00        | *                 |

#### 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