

| WASTE STREAM | 7V25 | Resin from Decontamination Operations ILW |
|--------------|------|-------------------------------------------|
|--------------|------|-------------------------------------------|

**SITE** NRTE Vulcan

**SITE OWNER** Ministry of Defence (MOD)

**WASTE CUSTODIAN** Ministry of Defence (MOD)

**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                |    |                               |                            |
| Future arisings:       | ~ 2.6                      |    |                               |                            |
| Total future arisings: | 0.0                        |    |                               |                            |
| Total waste volume:    | 2.6                        |    |                               |                            |

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

Comment on arising rates: Ion Exchange (IX) resin was generated historically during decontamination trials and primary circuit operations.

Additional information on quantities: Quantities of IX resin discharged from containers of known volumes. Assumptions on zero future arisings based on current site operating procedures.

Uncertainty factors on volumes: Stock (upper): x 1.25 Arisings (upper): x -  
Stock (lower): x 0.75 Arisings (lower): x -

**WASTE SOURCE** IX resin generated from treatment systems designed to reduce soluble activity from process liquors.

#### PHYSICAL CHARACTERISTICS

General description: The organic resins are in the form of loose spherical beads of 0.5-0.75mm diameter and consists of mixed anion/cation resin, Purolite NRW37. Due to the chemical process used the resin will also contain the organic chelating agent, EDTA.

Changes since waste generated: There has been no physical/chemical changes to the waste.

Bulk density (t/m<sup>3</sup>): ~ 0.70

Comment on density: Based on the ion exchange resin from the sampling datasheets.

#### CHEMICAL COMPOSITION

General description and components (%wt): 100% IX resin with trace organic chelating agent, EDTA.

Chemical state: Neutral

Sheet metal proportion / thickness: There are no metals in this waste stream.

Metals and alloys (%wt):

|                           | (%wt) | Type(s) / Grades(s) with proportions | % of total C14 activity |
|---------------------------|-------|--------------------------------------|-------------------------|
| Stainless steel.....      | 0     | -                                    |                         |
| Other ferrous metals..... | 0     | -                                    |                         |
| Iron.....                 | 0     | -                                    |                         |
| Aluminium.....            | 0     | -                                    |                         |
| Beryllium.....            | 0     | -                                    |                         |
| Cobalt.....               | 0     | -                                    |                         |
| Copper.....               | 0     | -                                    |                         |
| Lead.....                 | 0     | -                                    |                         |
| Magnox/Magnesium.....     | 0     | -                                    |                         |
| Nickel.....               | 0     | -                                    |                         |
| Titanium.....             | 0     | -                                    |                         |
| Uranium.....              | 0     | -                                    |                         |
| Zinc.....                 | 0     | -                                    |                         |
| Zircaloy/Zirconium.....   | 0     | -                                    |                         |
| Other metals.....         | 0     | -                                    |                         |

Organics (%wt):

|                                     | (%wt)   | Type(s) and comment | % of total C14 activity |
|-------------------------------------|---------|---------------------|-------------------------|
| Total cellulotics.....              | = 0     | -                   | 100.0                   |
| Paper, cotton.....                  | = 0     | -                   |                         |
| Wood.....                           | = 0     | -                   |                         |
| Halogenated plastics.....           | = 0     | -                   |                         |
| Total non-halogenated plastics..... | = 0     | -                   |                         |
| Condensation polymers.....          | = 0     | -                   |                         |
| Others.....                         | = 0     | -                   |                         |
| Organic ion exchange materials..... | = 100.0 | Purolite NRW37      |                         |
| Total rubber.....                   | = 0     | -                   |                         |
| Halogenated rubber.....             | = 0     | -                   |                         |
| Non-halogenated rubber.....         | = 0     | -                   |                         |
| Hydrocarbons.....                   | = 0     | -                   |                         |
| Oil or grease.....                  | = 0     | -                   |                         |
| Fuel.....                           | = 0     | -                   |                         |
| Asphalt/Tarmac (cont.coal tar)..... | = 0     | -                   |                         |
| Asphalt/Tarmac (no coal tar).....   | = 0     | -                   |                         |
| Bitumen.....                        | = 0     | -                   |                         |
| Others.....                         | = 0     | -                   |                         |
| Other organics.....                 | -       | -                   |                         |

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.....                             | 0     | -                   |                         |
| Glass/Ceramics.....                   | 0     | -                   |                         |
| Graphite.....                         | 0     | -                   |                         |
| Desiccants/Catalysts.....             | 0     | -                   |                         |
| Asbestos.....                         | 0     | -                   |                         |
| Non/low friable.....                  | 0     | -                   |                         |
| Moderately friable.....               | 0     | -                   |                         |
| Highly friable.....                   | 0     | -                   |                         |
| 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.....  | 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.....                    | = 0   | -                   |
| Corrosive materials.....                       | = 0   | -                   |
| Pyrophoric materials.....                      | = 0   | -                   |
| Generating toxic gases.....                    | = 0   | -                   |
| Reacting with water.....                       | = 0   | -                   |
| Higher activity particles.....                 | NE    | -                   |
| Soluble solids as bulk chemical compounds..... | NE    | -                   |

Hazardous substances / non hazardous pollutants:

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

Complexing agents (%wt):

| Yes                            |       |                     |
|--------------------------------|-------|---------------------|
|                                | (%wt) | Type(s) and comment |
| EDTA.....                      | ~ 1.6 | -                   |
| DPTA.....                      | = 0   | -                   |
| NTA.....                       | = 0   | -                   |
| Polycarboxylic acids.....      | = 0   | -                   |
| Other organic complexants..... | = 0   | -                   |
| Total complexing agents.....   | ~ 1.6 | -                   |

Physical components:

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

## TREATMENT, PACKAGING AND DISPOSAL

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

| Treatment                                                  | On-site / Off-site | Stream volume % |
|------------------------------------------------------------|--------------------|-----------------|
| Size reduction                                             |                    |                 |
| Decay storage                                              |                    |                 |
| Low force compaction                                       |                    |                 |
| Supercompaction (HFC)                                      |                    |                 |
| Incineration                                               |                    |                 |
| Drying/dewatering/liquid separation                        |                    |                 |
| Tie down/fixatives/strippable coating/painting application |                    |                 |
| Decontamination                                            |                    |                 |
| Metal treatment                                            |                    |                 |
| Recycling / reuse                                          |                    |                 |
| Thermal treatment, including vitrification                 |                    |                 |
| Encapsulation                                              |                    |                 |
| Polymer encapsulation                                      |                    |                 |
| Other physical treatment                                   |                    |                 |
| Other chemical treatment                                   |                    |                 |
| Containerisation                                           |                    |                 |
| Treatment not yet determined                               |                    |                 |
| None                                                       |                    | = 100.0         |

Comments on planned treatments:

No decisions made on decommissioning process until site handover in 2028, at which point NDA / NRS Dounreay will take ownership.

Conditioning method:

No decisions made on conditioning process until site handover in 2028, at which point NDA / NRS Dounreay will take ownership.

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 |
|                        | Not yet determined | 100.0                 | -                  | -            | -                  | -                                  |

Range in container waste loading:

Other information on packaging and conditioning: Packaging/treatment/conditioning process yet to be confirmed.

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                                                           | = 100.0         |                  |            |

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: Not yet determined

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

**RADIOACTIVITY**

Source: The waste arisings are from decontamination trials and from the reactor primary circuit.

Uncertainty: Undertaken by theoretical modelling as for ALARP reasons these resins could not be sampled

Measurement of radioactivities: Theoretical modelling

Chemical form of radionuclides: H-3: In liquid form  
C-14: As a carbonate.  
Cl-36: NE  
Se-79: NE  
Tc-99: NE  
I-129: NE  
Ra: Not detected  
Th: Not detected  
U: Ionic solution  
Np: Not detected  
Pu: Ionic solution

| WASTE STREAM 7V25 Resin from Decontamination Operations ILW |                            |                |                 |                |                  |                            |                |                 |                |
|-------------------------------------------------------------|----------------------------|----------------|-----------------|----------------|------------------|----------------------------|----------------|-----------------|----------------|
| 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                                                         | 3.65E+00                   | D D 2          |                 |                | Gd 153           |                            |                |                 |                |
| Be 10                                                       |                            |                |                 |                | Ho 163           |                            |                |                 |                |
| C 14                                                        | 4.71E-01                   | D D 2          |                 |                | Ho 166m          |                            |                |                 |                |
| Na 22                                                       |                            |                |                 |                | Tm 170           |                            |                |                 |                |
| Al 26                                                       |                            |                |                 |                | Tm 171           |                            |                |                 |                |
| Cl 36                                                       |                            |                |                 |                | Lu 174           |                            |                |                 |                |
| Ar 39                                                       |                            |                |                 |                | Lu 176           |                            |                |                 |                |
| Ar 42                                                       |                            |                |                 |                | Hf 178n          |                            |                |                 |                |
| K 40                                                        |                            |                |                 |                | Hf 182           |                            |                |                 |                |
| Ca 41                                                       |                            |                |                 |                | Pt 193           |                            |                |                 |                |
| Mn 53                                                       |                            |                |                 |                | Ti 204           |                            |                |                 |                |
| Mn 54                                                       |                            |                |                 |                | Pb 205           |                            |                |                 |                |
| Fe 55                                                       | 1.40E-04                   | D D 2          |                 |                | Pb 210           |                            |                |                 |                |
| Co 60                                                       | 1.78E-02                   | D D 2          |                 |                | Bi 208           |                            |                |                 |                |
| Ni 59                                                       |                            |                |                 |                | Bi 210m          |                            |                |                 |                |
| Ni 63                                                       | 2.38E-03                   | D D 2          |                 |                | Po 210           |                            |                |                 |                |
| Zn 65                                                       |                            |                |                 |                | Ra 223           |                            |                |                 |                |
| Se 79                                                       |                            |                |                 |                | Ra 225           |                            |                |                 |                |
| Kr 81                                                       |                            |                |                 |                | Ra 226           |                            |                |                 |                |
| Kr 85                                                       |                            |                |                 |                | Ra 228           |                            |                |                 |                |
| Rb 87                                                       |                            |                |                 |                | Ac 227           |                            |                |                 |                |
| Sr 90                                                       | 1.72E-01                   | D D 2          |                 |                | Th 227           |                            |                |                 |                |
| Zr 93                                                       |                            |                |                 |                | Th 228           |                            |                |                 |                |
| Nb 91                                                       |                            |                |                 |                | Th 229           |                            |                |                 |                |
| Nb 92                                                       |                            |                |                 |                | Th 230           |                            |                |                 |                |
| Nb 93m                                                      |                            |                |                 |                | Th 232           |                            |                |                 |                |
| Nb 94                                                       |                            |                |                 |                | Th 234           |                            |                |                 |                |
| Mo 93                                                       |                            |                |                 |                | Pa 231           |                            |                |                 |                |
| Tc 97                                                       |                            |                |                 |                | Pa 233           |                            |                |                 |                |
| Tc 99                                                       |                            |                |                 |                | U 232            | 4.22E-09                   | D D 5          |                 |                |
| Ru 106                                                      |                            |                |                 |                | U 233            | 6.00E-09                   | D D 5          |                 |                |
| Pd 107                                                      |                            |                |                 |                | U 234            | 6.00E-09                   | D D 5          |                 |                |
| Ag 108m                                                     | 2.87E-06                   | D D 2          |                 |                | U 235            | 2.20E-09                   | D D 5          |                 |                |
| Ag 110m                                                     |                            |                |                 |                | U 236            | 2.20E-09                   | D D 5          |                 |                |
| Cd 109                                                      |                            |                |                 |                | U 238            | 3.16E-08                   | D D 5          |                 |                |
| Cd 113m                                                     |                            |                |                 |                | Np 237           |                            |                |                 |                |
| Sn 119m                                                     |                            |                |                 |                | Pu 236           |                            |                |                 |                |
| Sn 121m                                                     |                            |                |                 |                | Pu 238           | 1.00E-05                   | D D 5          |                 |                |
| Sn 123                                                      |                            |                |                 |                | Pu 239           | 1.60E-07                   | D D 5          |                 |                |
| Sn 126                                                      |                            |                |                 |                | Pu 240           | 1.60E-07                   | D D 5          |                 |                |
| Sb 125                                                      | 1.04E-02                   | D D 2          |                 |                | Pu 241           | 1.14E-05                   | D D 5          |                 |                |
| Sb 126                                                      |                            |                |                 |                | Pu 242           | 2.98E-09                   | D D 5          |                 |                |
| Te 125m                                                     |                            |                |                 |                | Am 241           | 7.38E-09                   | D D 5          |                 |                |
| Te 127m                                                     |                            |                |                 |                | Am 242m          |                            |                |                 |                |
| I 129                                                       |                            |                |                 |                | Am 243           |                            |                |                 |                |
| Cs 134                                                      | 3.26E-03                   | D D 2          |                 |                | Cm 242           | 9.18E-10                   | D D 5          |                 |                |
| Cs 135                                                      |                            |                |                 |                | Cm 243           | 5.00E-10                   | D D 5          |                 |                |
| Cs 137                                                      | 4.47E-02                   | D D 2          |                 |                | Cm 244           | 5.00E-10                   | D D 5          |                 |                |
| Ba 133                                                      |                            |                |                 |                | Cm 245           |                            |                |                 |                |
| La 137                                                      |                            |                |                 |                | Cm 246           |                            |                |                 |                |
| La 138                                                      |                            |                |                 |                | Cm 248           |                            |                |                 |                |
| Ce 144                                                      |                            |                |                 |                | Cf 249           |                            |                |                 |                |
| Pm 145                                                      |                            |                |                 |                | Cf 250           |                            |                |                 |                |
| Pm 147                                                      |                            |                |                 |                | Cf 251           |                            |                |                 |                |
| Sm 147                                                      |                            |                |                 |                | Cf 252           |                            |                |                 |                |
| Sm 151                                                      |                            |                |                 |                | Unsp a           |                            |                |                 |                |
| Eu 152                                                      |                            |                |                 |                | Unsp b/g         |                            |                |                 |                |
| Eu 154                                                      |                            |                |                 |                | <b>Total a</b>   | <b>1.04E-05</b>            | *              | <b>0</b>        | *              |
| Eu 155                                                      |                            |                |                 |                | <b>Total b/g</b> | <b>4.37E+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