

| WASTE STREAM | 9D41/2 | FED Magnox - R1 |
|--------------|--------|-----------------|
|--------------|--------|-----------------|

**SITE** Hinkley Point 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                | = 42.0 |                               |                            |
| Future arisings:       |                            |        |                               |                            |
| Total future arisings: |                            | 0.0    |                               |                            |
| Total waste volume:    |                            | 42.0   |                               |                            |

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

Comment on arising rates: -

Additional information on quantities: In calculating the volumes it has been assumed that the waste has a bulk density of 0.5t/m3. The total volume of waste will not be known until the waste is retrieved; however it is anticipated to be between 24m3 and 60m3.

Uncertainty factors on volumes:

|                |        |                   |     |
|----------------|--------|-------------------|-----|
| Stock (upper): | x 1.30 | Arisings (upper): | x - |
| Stock (lower): | x 0.70 | Arisings (lower): | x - |

**WASTE SOURCE** Removal of splitters from fuel elements prior to dispatch of the elements to Sellafield.

#### PHYSICAL CHARACTERISTICS

General description: The waste consists of Magnox metal and swarf contaminated with a significant volume of pond sludge. Individual components may weigh up to about 100 g and be approx. 2 mm x 25 mm x (75-900) mm. Nimonic springs will also be present (see waste stream 9D43). There are no large items in the waste which will require special handling.

Changes since waste generated: -

Bulk density (t/m<sup>3</sup>): = 0.50

Comment on density: The bulk density of the waste ranges from 0.1 to 1.7 t/m3 with an average density of 0.5 t/m3. The packing factor will be variable.

#### CHEMICAL COMPOSITION

General description and components (%wt): Magnox Metal (Zr 55) (99.5% wt), zirconium alloy (0.5% wt) in fuel element top end fittings. Activation of trace components within the Magnox. Fission product and actinide contamination. Magnesium carbonate and hydroxide may also be present.

Chemical state: Alkali

Sheet metal proportion / thickness: No bulk metal items expected.

Metals and alloys (%wt):

|                           | (%wt)  | Type(s) / Grades(s) with proportions                                        | % of total C14 activity |
|---------------------------|--------|-----------------------------------------------------------------------------|-------------------------|
| Stainless steel.....      | = 0    | -                                                                           |                         |
| Other ferrous metals..... | = 0    | -                                                                           |                         |
| Iron.....                 |        | -                                                                           |                         |
| Aluminium.....            | = 0    | -                                                                           |                         |
| Beryllium.....            | TR     | -                                                                           |                         |
| Cobalt.....               |        | -                                                                           |                         |
| Copper.....               | = 0    | -                                                                           |                         |
| Lead.....                 | = 0    | -                                                                           |                         |
| Magnox/Magnesium.....     | = 99.5 | Magnox alloy Zr 55, contains 0.55 wt% zirconium as an alloying constituent. |                         |
| Nickel.....               |        | -                                                                           |                         |
| Titanium.....             |        | -                                                                           |                         |
| Uranium.....              |        | -                                                                           |                         |
| Zinc.....                 | = 0    | -                                                                           |                         |
| Zircaloy/Zirconium.....   | = 0.50 | -                                                                           |                         |
| Other metals.....         | TR     | Manganese.                                                                  |                         |

Organics (%wt):

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

Other materials (%wt):

|                                       | (%wt) | Type(s) and comment | % of total C14 activity |
|---------------------------------------|-------|---------------------|-------------------------|
| Inorganic ion exchange materials..... | = 0   | -                   |                         |
| Inorganic sludges and flocs.....      | NE    | -                   |                         |
| Soil.....                             | = 0   | -                   |                         |
| Brick/Stone/Rubble.....               | = 0   | -                   |                         |
| Cementitious material.....            | = 0   | -                   |                         |
| Sand.....                             |       | -                   |                         |
| Glass/Ceramics.....                   | = 0   | -                   |                         |
| Graphite.....                         | TR    | -                   |                         |
| Desiccants/Catalysts.....             |       | -                   |                         |
| Asbestos.....                         | = 0   | -                   |                         |
| Non/low friable.....                  |       | -                   |                         |
| Moderately friable.....               |       | -                   |                         |
| Highly friable.....                   |       | -                   |                         |
| Free aqueous liquids.....             | TR    | -                   |                         |
| Free non-aqueous liquids.....         | = 0   | -                   |                         |
| Powder/Ash.....                       | TR    | -                   |                         |

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

Inorganic anions (%wt):

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

Materials of interest for waste acceptance criteria:

|                                                | (%wt)  | Type(s) and comment |
|------------------------------------------------|--------|---------------------|
| Combustible metals.....                        | ~ 99.5 | -                   |
| 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.....                       | ~ 99.5 | -                   |
| 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:

Conditioning plants:

| Plant Name | Location        |
|------------|-----------------|
| HPA ATCS   | Hinkley Point A |

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 |
|------------------------|------------------------|-----------------------|--------------------|--------------|--------------------|------------------------------------|
|                        | 500 l RS drum (0mm Pb) | 100.0                 | 0.47               | 0.49         | 90                 | -                                  |

Range in container waste loading: It is assumed that 3 compacted drums will be loaded into the container.

Other information on packaging and conditioning: -

Conditioned density (t/m³): -

Conditioned density comment: -

**Management Routes:**

| Disposal Route                                                                     | Stream volume % | Raw density t/m³ | Start date |
|------------------------------------------------------------------------------------|-----------------|------------------|------------|
| Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland) | 100.0           |                  |            |
| Expected to be Non-NSD HAW managed under Scottish Government's policy              |                 |                  |            |
| Expected to be disposed to LLW Vaults NRS Dounreay                                 |                 |                  |            |
| Expected to be consigned to the Geological Disposal Facility                       |                 |                  |            |
| Expected to be consigned to a Near Surface Disposal Facility                       |                 |                  |            |
| Expected to be consigned to the LLW Repository                                     |                 |                  |            |
| Expected to be consigned to a Landfill Facility                                    |                 |                  |            |
| Expected to be disposed On-Site                                                    |                 |                  |            |
| Expected to be managed by In-Situ Disposal                                         |                 |                  |            |
| Expected to be consigned to an Incineration Facility                               |                 |                  |            |
| Expected to be consigned to a Metal Treatment Facility                             |                 |                  |            |
| Expected to be Out of Scope                                                        |                 |                  |            |
| Expected to be recycled / reused                                                   |                 |                  |            |
| Disposal route not known                                                           |                 |                  |            |

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

Opportunities for alternative disposal routing: No

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

**RADIOACTIVITY**

Source: The source of the waste is the removal of splitters from fuel elements prior to dispatch of the elements to Sellafield. Activation of trace nuclides in the Magnox and contamination by fission products and actinides will be main sources of activity.

Uncertainty: The values quoted are indicative of the activities that might be expected.

Measurement of radioactivities: Values were derived from measurements, calculations of induced activity and estimates of likely contamination. Allowance has been made for zirconium alloy in top end fittings.

Chemical form of radionuclides:

H-3: Most tritium is expected to be present as surface contamination, possibly as water but perhaps in the form of other inorganic compounds or as organic compounds.

C-14: Carbon 14 will probably be present as graphite.

Cl-36: Chlorine 36 incorporated in the Magnox may be associated with barium impurity (barium chloride). Other chlorine 36 may be associated with surface contamination.

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 may be uranium oxides.

Np: The chemical form of neptunium has not been determined.

Pu: The chemical form of plutonium isotopes may be plutonium oxides.

| WASTE STREAM 9D41/2 FED Magnox - 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                                 | 5.62E-03                   | C C 2          |                 |                | Gd 153           |                            | 8              |                 |                |
| Be 10                               | 2.04E-07                   | C C 2          |                 |                | Ho 163           | 1.81E-08                   | C C 2          |                 |                |
| C 14                                | 5.56E-04                   | C C 2          |                 |                | Ho 166m          | 2.36E-05                   | C C 2          |                 |                |
| Na 22                               |                            | 8              |                 |                | Tm 170           |                            | 8              |                 |                |
| Al 26                               | 2.91E-05                   | C C 2          |                 |                | Tm 171           |                            | 8              |                 |                |
| Cl 36                               | 1.95E-05                   | C C 2          |                 |                | Lu 174           |                            | 8              |                 |                |
| Ar 39                               |                            | 8              |                 |                | Lu 176           |                            | 8              |                 |                |
| Ar 42                               |                            | 8              |                 |                | Hf 178n          |                            | 8              |                 |                |
| K 40                                | < 3.50E-06                 | C 3            |                 |                | Hf 182           |                            | 8              |                 |                |
| Ca 41                               | 1.61E-07                   | C C 2          |                 |                | Pt 193           |                            | 8              |                 |                |
| Mn 53                               |                            | 8              |                 |                | Ti 204           | 5.06E-07                   | C C 2          |                 |                |
| Mn 54                               | < 1.20E-09                 | C 3            |                 |                | Pb 205           |                            | 8              |                 |                |
| Fe 55                               | 3.83E-06                   | C C 2          |                 |                | Pb 210           |                            | 8              |                 |                |
| Co 60                               | 1.27E-04                   | C C 2          |                 |                | Bi 208           |                            | 8              |                 |                |
| Ni 59                               | 1.64E-05                   | C C 2          |                 |                | Bi 210m          |                            | 8              |                 |                |
| Ni 63                               | 1.47E-03                   | C C 2          |                 |                | Po 210           |                            | 8              |                 |                |
| Zn 65                               |                            | 8              |                 |                | Ra 223           |                            | 8              |                 |                |
| Se 79                               |                            | 8              |                 |                | Ra 225           |                            | 8              |                 |                |
| Kr 81                               |                            | 8              |                 |                | Ra 226           |                            | 8              |                 |                |
| Kr 85                               |                            | 8              |                 |                | Ra 228           |                            | 8              |                 |                |
| Rb 87                               |                            | 8              |                 |                | Ac 227           |                            | 8              |                 |                |
| Sr 90                               | 8.07E-03                   | C C 2          |                 |                | Th 227           |                            | 8              |                 |                |
| Zr 93                               | 3.43E-09                   | C C 2          |                 |                | Th 228           | 1.61E-06                   | C C 2          |                 |                |
| Nb 91                               |                            | 8              |                 |                | Th 229           |                            | 8              |                 |                |
| Nb 92                               |                            | 8              |                 |                | Th 230           |                            | 8              |                 |                |
| Nb 93m                              | 2.68E-06                   | C C 2          |                 |                | Th 232           |                            | 8              |                 |                |
| Nb 94                               | 6.73E-08                   | C C 2          |                 |                | Th 234           | < 5.82E-07                 | C 3            |                 |                |
| Mo 93                               | 6.46E-09                   | C C 2          |                 |                | Pa 231           |                            | 8              |                 |                |
| Tc 97                               |                            | 8              |                 |                | Pa 233           | 1.33E-06                   | C C 2          |                 |                |
| Tc 99                               | 3.58E-05                   | C C 2          |                 |                | U 232            | 1.71E-06                   | C C 2          |                 |                |
| Ru 106                              | 5.06E-08                   | C C 2          |                 |                | U 233            | < 2.45E-06                 | C 3            |                 |                |
| Pd 107                              |                            | 8              |                 |                | U 234            | 1.13E-06                   | C C 2          |                 |                |
| Ag 108m                             | 1.94E-06                   | C C 2          |                 |                | U 235            | 1.56E-08                   | C C 2          |                 |                |
| Ag 110m                             |                            | 8              |                 |                | U 236            | 7.75E-08                   | C C 2          |                 |                |
| Cd 109                              | < 1.06E-07                 | C 3            |                 |                | U 238            | 5.82E-07                   | C C 2          |                 |                |
| Cd 113m                             | 1.95E-05                   | C C 2          |                 |                | Np 237           | < 1.33E-06                 | C 3            |                 |                |
| Sn 119m                             |                            | 8              |                 |                | Pu 236           |                            | 8              |                 |                |
| Sn 121m                             | 1.31E-05                   | C C 2          |                 |                | Pu 238           | 1.35E-04                   | C C 2          |                 |                |
| Sn 123                              |                            | 8              |                 |                | Pu 239           | 2.52E-04                   | C C 2          |                 |                |
| Sn 126                              |                            | 8              |                 |                | Pu 240           | 2.58E-04                   | C C 2          |                 |                |
| Sb 125                              | 2.07E-09                   | C C 2          |                 |                | Pu 241           | 2.73E-03                   | C C 2          |                 |                |
| Sb 126                              |                            | 8              |                 |                | Pu 242           | 1.36E-06                   | C C 2          |                 |                |
| Te 125m                             |                            | 8              |                 |                | Am 241           | 9.71E-04                   | C C 2          |                 |                |
| Te 127m                             |                            | 8              |                 |                | Am 242m          |                            | 8              |                 |                |
| I 129                               |                            | 8              |                 |                | Am 243           |                            | 8              |                 |                |
| Cs 134                              |                            | 8              |                 |                | Cm 242           |                            | 8              |                 |                |
| Cs 135                              |                            | 8              |                 |                | Cm 243           | 2.66E-07                   | C C 2          |                 |                |
| Cs 137                              | 8.68E-04                   | C C 2          |                 |                | Cm 244           | 2.95E-06                   | C C 2          |                 |                |
| Ba 133                              | 5.44E-06                   | C C 2          |                 |                | Cm 245           |                            | 8              |                 |                |
| La 137                              | 1.73E-09                   | C C 2          |                 |                | Cm 246           |                            | 8              |                 |                |
| La 138                              |                            | 8              |                 |                | Cm 248           |                            | 8              |                 |                |
| Ce 144                              | < 3.48E-09                 | C 3            |                 |                | Cf 249           |                            | 8              |                 |                |
| Pm 145                              | 2.13E-07                   | C C 2          |                 |                | Cf 250           |                            | 8              |                 |                |
| Pm 147                              | 1.43E-06                   | C C 2          |                 |                | Cf 251           |                            | 8              |                 |                |
| Sm 147                              |                            | 8              |                 |                | Cf 252           |                            | 8              |                 |                |
| Sm 151                              | 7.60E-04                   | C C 2          |                 |                | Unsp a           |                            |                |                 |                |
| Eu 152                              | 3.49E-06                   | C C 2          |                 |                | Unsp b/g         |                            |                |                 |                |
| Eu 154                              | 2.13E-05                   | C C 2          |                 |                | <b>Total a</b>   | <b>1.63E-03</b>            | *              | <b>0</b>        | *              |
| Eu 155                              | 5.29E-08                   | C C 2          |                 |                | <b>Total b/g</b> | <b>2.04E-02</b>            | *              | <b>0</b>        | *              |

#### Bands (Upper and Lower)

A a factor of 1.5  
B a factor of 3  
C a factor of 10  
D a factor of 100  
E a factor of 1000

Note: Bands quantify uncertainty in the mean radioactivity.

#### Code

1 Measured activity  
2 Derived activity (best estimate)  
3 Derived activity (upper limit)  
4 Not present  
5 Present but not significant  
6 Likely to be present but not assessed  
7 Present in significant quantities but not determined  
8 Not expected to be present in significant quantity  
\* Total calculated from the 114 declared radionuclides