

|                     |              |                             |
|---------------------|--------------|-----------------------------|
| <b>WASTE STREAM</b> | <b>9E318</b> | <b>Secondary Wastes LLW</b> |
|---------------------|--------------|-----------------------------|

**SITE** Oldbury  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Magnox Limited  
**WASTE TYPE** LLW

**WASTE VOLUMES**

|                        |                           | Reported              |
|------------------------|---------------------------|-----------------------|
| Stocks:                | At 1.4.2019.....          | 0 m <sup>3</sup>      |
| Future arisings -      | 1.4.2096 - 31.3.2101..... | 1206.0 m <sup>3</sup> |
| Total future arisings: |                           | 1206.0 m <sup>3</sup> |
| Total waste volume:    |                           | 1206.0 m <sup>3</sup> |

Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 5 years. Waste generation of this stream is assumed to commence in 2096. Volumes and radioactivity have been calculated for 85 years after reactor shutdown.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.2  
 Stock (lower): x Arisings (lower) x 0.8

**WASTE SOURCE** Wastes arising from contamination control procedures during plant dismantling.

**PHYSICAL CHARACTERISTICS**

General description: A variety of combustible and non combustible materials. No large items are expected.  
 Physical components (%vol): Metallic pipe and other items (~50% vol), plastic pipework, sheet and other items (~10% vol), rubber gloves and other items (~5% vol), clothing (~5% vol), wood (~5% vol), encapsulated sludge (~5% vol), air filters (~5% vol), combustible material (e.g. paper sheet) (~15-20 % vol). Percentages of constituents are very uncertain.  
 Sealed sources: -  
 Bulk density (t/m<sup>3</sup>): ~1  
 Comment on density: The density is likely to lie between 0.5 and 1.5 t/m<sup>3</sup>.

**CHEMICAL COMPOSITION**

General description and components (%wt): The waste is expected to include cloth (~5%vol), plastics (~15%vol), paper (~15%vol), wood (~5%vol), rubber (~5%vol), encapsulated sludge (~5%vol) and metals (~50%vol). Percentages of constituents are very uncertain.

Chemical state: Neutral  
 Chemical form of radionuclides: H-3: The chemical form of tritium has not been assessed.  
 C-14: The chemical form of carbon 14 has not been assessed.  
 Cl-36: The chemical form of chlorine 36 has not been assessed.  
 Se-79: The selenium content is insignificant.  
 Tc-99: The technetium content is insignificant.  
 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 plutonium isotope content is insignificant.

Metals and alloys (%wt): Items will have been cut for packaging but an assessment of item dimensions has not been made. The metal thickness will probably be typically 1-3 mm.

|                           |       |
|---------------------------|-------|
| Stainless steel.....      | <<1.0 |
| Other ferrous metals..... | ~50.0 |
| Iron.....                 |       |
| Aluminium.....            | <<1.0 |
| Beryllium.....            | 0     |
| Cobalt.....               |       |
| Copper.....               | <<1.0 |
| Lead.....                 | 0     |

**WASTE STREAM**

**9E318 Secondary Wastes LLW**

Magnox/Magnesium..... 0  
 Nickel.....  
 Titanium.....  
 Uranium.....  
 Zinc..... 0  
 Zircaloy/Zirconium..... 0  
 Other metals..... <<1.0

There may be "other" metals present (<<1%). Apart from steels only small quantities of metals and alloys are expected.

Organics (%wt):

A wide variety of materials may be present. Halogenated plastics and rubbers are expected but the materials have not been determined.

Total cellulosics..... ~25.0  
     Paper, cotton..... ~20.0  
     Wood..... ~5.0  
 Halogenated plastics ..... <7.5  
 Total non-halogenated plastics..... <7.5  
     Condensation polymers..... <3.8  
     Others..... <3.8  
 Organic ion exchange materials.... 0  
 Total rubber..... ~5.0  
     Halogenated rubber ..... <2.5  
     Non-halogenated rubber..... <2.5  
 Hydrocarbons.....  
     Oil or grease .....  
     Fuel.....  
     Asphalt/Tarmac (cont.coal tar)...  
     Asphalt/Tarmac (no coal tar)....  
     Bitumen.....  
     Others.....  
 Other organics..... TR

Other materials (%wt):

Graphite may be present in at least trace quantities.

Inorganic ion exchange materials. 0  
 Inorganic sludges and flocs..... 0  
 Soil..... TR  
 Brick/Stone/Rubble..... TR  
 Cementitious material..... 5.0  
 Sand.....  
 Glass/Ceramics..... 0  
 Graphite..... TR  
 Desiccants/Catalysts.....  
 Asbestos..... 0  
     Non/low friable.....  
     Moderately friable.....

encapsulated sludges

**WASTE STREAM****9E318****Secondary Wastes LLW**

|  |   |    |
|--|---|----|
|  | Highly friable.....   |    |
|  | Free aqueous liquids.....   | 0  |
|  | Free non-aqueous liquids.....   | 0  |
|  | Powder/Ash.....   | 0  |
| Inorganic anions (%wt):                              | Not fully assessed. Only expected to be present in trace quantities.                      |    |
|  | Fluoride.....   | TR |
|  | Chloride.....   | TR |
|  | Iodide.....   | 0  |
|  | Cyanide.....  | 0  |
|  | Carbonate.....  | TR |
|  | Nitrate.....  | TR |
|  | Nitrite.....  | TR |
|  | Phosphate.....  | TR |
|  | Sulphate.....   | TR |
|  | Sulphide.....   | TR |
| Materials of interest for waste acceptance criteria: | No materials likely to pose a fire or other non-radiological hazard have been identified. |    |
|  | Combustible metals.....   | 0  |
|  | Low flash point liquids.....  | 0  |
|  | Explosive materials.....  | 0  |
|  | Phosphorus.....   | 0  |
|  | Hydrides.....   | 0  |
|  | Biological etc. materials.....  | 0  |
|  | Biodegradable materials.....  |    |
|  | Putrescible wastes.....   | 0  |
|  | Non-putrescible wastes.....   |    |
|  | Corrosive materials.....  | 0  |
|  | Pyrophoric materials.....   | 0  |
|  | Generating toxic gases.....   | 0  |
|  | Reacting with water.....  | 0  |
|  | Active particles.....   |    |
|  | Soluble solids as bulk chemical compounds.....  |    |
| Hazardous substances / non hazardous pollutants:     | None expected.  |    |
|  | Acrylamide.....   |    |
|  | Benzene.....  |    |
|  | Chlorinated solvents.....   |    |
|  | Formaldehyde.....   |    |
|  | Organometallics.....  |    |
|  | Phenol.....   |    |
|  | Styrene.....  |    |
|  | Tri-butyl phosphate.....  |    |

**WASTE STREAM****9E318****Secondary Wastes LLW**

Other organophosphates.....  
 Vinyl chloride.....  
 Arsenic.....  
 Barium.....  
 Boron.....  
 Cadmium.....  
 Caesium.....  
 Selenium.....  
 Chromium.....  
 Molybdenum.....  
 Thallium.....  
 Tin.....  
 Vanadium.....  
 Mercury compounds.....  
 Others.....  
 Electronic Electrical Equipment (EEE)  
   EEE Type 1.....  
   EEE Type 2.....  
   EEE Type 3.....  
   EEE Type 4.....  
   EEE Type 5.....

Complexing agents (%wt):

EDTA.....  
 DPTA.....  
 NTA.....  
 Polycarboxylic acids.....  
 Other organic complexants.....  
 Total complexing agents..... TR

**TREATMENT, PACKAGING AND DISPOSAL**

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

| Treatment             | On-site / Off site | Stream volume % |
|-----------------------|--------------------|-----------------|
| Low force compaction  |                    |                 |
| Supercompaction (HFC) |                    |                 |
| Incineration          |                    |                 |
| Solidification        |                    |                 |
| Decontamination       |                    |                 |
| Metal treatment       |                    |                 |
| Size reduction        |                    |                 |
| Decay storage         |                    |                 |
| Recycling / reuse     |                    |                 |
| Other / various       |                    |                 |
| None                  |                    | 100.0           |

Comment on planned treatments:

-

**WASTE STREAM****9E318****Secondary Wastes LLW****Disposal Routes:**

| Disposal Route  | Stream volume % |
|---|-----------------|
| Expected to be consigned to the LLW Repository<br>Expected to be consigned to a Landfill Facility<br>Expected to be consigned to an On-Site Disposal Facility<br>Expected to be consigned to an Incineration Facility<br>Expected to be consigned to a Metal Treatment Facility<br>Expected to be consigned as Out of Scope<br>Expected to be recycled / reused<br>Disposal route not known | 100.0           |

**Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):**

| Disposal Route  | Stream volume % |         |         |
|---|-----------------|---------|---------|
|   | 2019/20         | 2020/21 | 2021/22 |
| Expected to be consigned to the LLW Repository<br>Expected to be consigned to a Landfill Facility<br>Expected to be consigned to an On-Site Disposal Facility<br>Expected to be consigned to an Incineration Facility<br>Expected to be consigned to a Metal Treatment Facility<br>Expected to be consigned as Out of Scope<br>Expected to be recycled / reused<br>Disposal route not known |                 |         |         |

**Waste Packaging for Disposal:** (Not applicable to this waste stream)

| Container  | Stream volume % | Waste loading m <sup>3</sup> | Number of packages |
|--|-----------------|------------------------------|--------------------|
| 1/3 Height IP-1 ISO<br>2/3 Height IP-2 ISO<br>1/2 Height WAMAC IP-2 ISO<br>1/2 Height IP-2 Disposal/Re-usable ISO<br>2m box (no shielding)<br>4m box (no shielding)<br>Other |                 |                              |                    |

Other information: -

**Waste Planned for Disposal at the LLW Repository:** (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: -

Potential for the waste to contain discrete items: -

**Non-Containerised Waste for In-Vault Grouting:** (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

**RADIOACTIVITY**

**WASTE STREAM****9E318****Secondary Wastes LLW**

|   |   |
|---|---|
| Source:   | Contamination by activation products from the reactor structure.  |
| Uncertainty:                                    | Only very approximate estimates have been made of the specific activities.  |
| Definition of total alpha and total beta/gamma: | Total beta/gamma is defined as the sum of the listed activities of all nuclides other than alpha emitters. Total alpha activity is insignificant.   |
| Measurement of radioactivities:                 | The contamination is assumed to arise from all the ILW and LLW streams. A total specific activity for beta/gamma emitters has been assumed and the isotopic contribution has been determined by a weighted contribution from each stream. |
| Other information:                              | The activities quoted are those at the time of Final Site Clearance (about 85 years after Station shutdown).  |

**WASTE STREAM**

**9E318**

**Secondary Wastes LLW**

| Nuclide | Mean radioactivity, TBq/m <sup>3</sup> |                |                 |                | Nuclide          | Mean radioactivity, TBq/m <sup>3</sup> |                |                 |                |
|---------|--|----------------|-----------------|----------------|------------------|--|----------------|-----------------|----------------|
|         | Waste at 1.4.2019                      | Bands and Code | Future arisings | Bands and Code |                  | Waste at 1.4.2019                      | Bands and Code | Future arisings | Bands and Code |
| H 3     |  |                | 9.82E-07        | C C 2          | Gd 153           |  |                |                 | 8              |
| Be 10   |  |                |                 | 8              | Ho 163           |  |                |                 | 8              |
| C 14    |  |                | 5.54E-05        | C C 2          | Ho 166m          |  |                |                 | 8              |
| Na 22   |  |                |                 | 8              | Tm 170           |  |                |                 | 8              |
| Al 26   |  |                |                 | 8              | Tm 171           |  |                |                 | 8              |
| Cl 36   |  |                | 1.17E-07        | C C 2          | Lu 174           |  |                |                 | 8              |
| Ar 39   |  |                |                 | 8              | Lu 176           |  |                |                 | 8              |
| Ar 42   |  |                |                 | 8              | Hf 178n          |  |                |                 | 8              |
| K 40    |  |                |                 | 8              | Hf 182           |  |                |                 | 8              |
| Ca 41   |  |                | 1.74E-07        | C C 2          | Pt 193           |  |                |                 | 8              |
| Mn 53   |  |                |                 | 8              | Tl 204           |  |                |                 | 8              |
| Mn 54   |  |                |                 | 8              | Pb 205           |  |                |                 | 8              |
| Fe 55   |  |                |                 | 8              | Pb 210           |  |                |                 | 8              |
| Co 60   |  |                | 1.71E-08        | C C 2          | Bi 208           |  |                |                 | 8              |
| Ni 59   |  |                | 6.53E-07        | C C 2          | Bi 210m          |  |                |                 | 8              |
| Ni 63   |  |                | 4.25E-05        | 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   |  |                |                 | 6              | Th 227           |  |                |                 | 8              |
| Zr 93   |  |                |                 | 8              | Th 228           |  |                |                 | 8              |
| Nb 91   |  |                |                 | 8              | Th 229           |  |                |                 | 8              |
| Nb 92   |  |                |                 | 8              | Th 230           |  |                |                 | 8              |
| Nb 93m  |  |                |                 | 6              | Th 232           |  |                |                 | 8              |
| Nb 94   |  |                | 9.85E-08        | C C 2          | Th 234           |  |                |                 | 8              |
| Mo 93   |  |                | 6.62E-09        | C C 2          | Pa 231           |  |                |                 | 8              |
| Tc 97   |  |                |                 | 8              | Pa 233           |  |                |                 | 8              |
| Tc 99   |  |                | 1.47E-09        | C C 2          | U 232            |  |                |                 | 8              |
| Ru 106  |  |                |                 | 8              | U 233            |  |                |                 | 8              |
| Pd 107  |  |                |                 | 8              | U 234            |  |                |                 | 8              |
| Ag 108m |  |                | 2.37E-09        | C C 2          | U 235            |  |                |                 | 8              |
| Ag 110m |  |                |                 | 8              | U 236            |  |                |                 | 8              |
| Cd 109  |  |                |                 | 8              | U 238            |  |                |                 | 8              |
| Cd 113m |  |                |                 | 8              | Np 237           |  |                |                 | 8              |
| Sn 119m |  |                |                 | 8              | Pu 236           |  |                |                 | 8              |
| Sn 121m |  |                | 8.7E-08         | C C 2          | Pu 238           |  |                |                 | 6              |
| Sn 123  |  |                |                 | 8              | Pu 239           |  |                |                 | 6              |
| Sn 126  |  |                |                 | 8              | Pu 240           |  |                |                 | 6              |
| Sb 125  |  |                |                 | 8              | Pu 241           |  |                |                 | 8              |
| Sb 126  |  |                |                 | 8              | Pu 242           |  |                |                 | 8              |
| Te 125m |  |                |                 | 8              | Am 241           |  |                |                 | 8              |
| Te 127m |  |                |                 | 8              | Am 242m          |  |                |                 | 8              |
| I 129   |  |                |                 | 8              | Am 243           |  |                |                 | 8              |
| Cs 134  |  |                |                 | 8              | Cm 242           |  |                |                 | 8              |
| Cs 135  |  |                |                 | 8              | Cm 243           |  |                |                 | 8              |
| Cs 137  |  |                | 1.02E-09        | C C 2          | Cm 244           |  |                |                 | 8              |
| Ba 133  |  |                |                 | 8              | Cm 245           |  |                |                 | 8              |
| La 137  |  |                |                 | 8              | Cm 246           |  |                |                 | 8              |
| La 138  |  |                |                 | 8              | Cm 248           |  |                |                 | 8              |
| Ce 144  |  |                |                 | 8              | Cf 249           |  |                |                 | 8              |
| Pm 145  |  |                |                 | 8              | Cf 250           |  |                |                 | 8              |
| Pm 147  |  |                |                 | 8              | Cf 251           |  |                |                 | 8              |
| Sm 147  |  |                |                 | 8              | Cf 252           |  |                |                 | 8              |
| Sm 151  |  |                | 1.11E-09        | C C 2          | Other a          |  |                |                 |                |
| Eu 152  |  |                | 8.81E-09        | C C 2          | Other b/g        |  |                |                 |                |
| Eu 154  |  |                |                 | 8              | <b>Total a</b>   | <b>0</b>                               |                | <b>0</b>        |                |
| Eu 155  |  |                |                 | 8              | <b>Total b/g</b> | <b>0</b>                               |                | <b>1.00E-04</b> | <b>C C 2</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 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