## WASTE STREAM 9E310 Stainless Steel (Reactor) ILW

**SITE** Oldbury

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** ILW

**WASTE VOLUMES**

| | | Reported |
|---|---|---|
| Stocks: | At 1.4.2019..... | 0 m³ |
| Future arisings - | 1.4.2096 - 31.3.2101..... | 80.5 m³ |
| Total future arisings: | | 80.5 m³ |
| Total waste volume: | | 80.5 m³ |

Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 5 years. Final Site Clearance is assumed to commence in 2091. 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** Stainless steel items from reactor dismantling.

### PHYSICAL CHARACTERISTICS

General description: A variety of stainless steel items.

Physical components (%vol): Stainless steel items (100%).

Sealed sources: -

Bulk density (t/m³): ~1.4

Comment on density: The density is of the waste as cut for packaging.

### CHEMICAL COMPOSITION

General description and components (%wt): Stainless steels (100%).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: The tritium content is insignificant.
C-14: The carbon 14 will be incorporated in the steel. There also may be some graphite contamination.
Cl-36: The chlorine 36 will be incorporated in the steel.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
Ra: The radium content is insignificant.
Th: The thorium content is insignificant.
U: The uranium content is insignificant.
Np: The neptunium content is insignificant.
Pu: The plutonium content is insignificant.

Metals and alloys (%wt): Items will have been cut for packaging. Thicknesses are likely to vary from a few mm to about 25 mm.

| | | |
|---|---|---|
| Stainless steel..... | 100.0 | Stainless steel types are BS1631/1950 and EN58B. |
| Other ferrous metals..... | 0 | |
| Iron..... | | |
| Aluminium..... | 0 | |
| Beryllium..... | 0 | |
| Cobalt..... | | |
| Copper..... | 0 | |
| Lead..... | 0 | |
| Magnox/Magnesium..... | 0 | |

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| | | | |
|---|---|---|---|
| | Nickel..... | | |
| | Titanium..... | | |
| | Uranium..... | | |
| | Zinc..... | 0 | |
| | Zircaloy/Zirconium..... | 0 | |
| | Other metals..... | 0 | There are no "other" metals. |
| Organics (%wt): | None expected. No halogenated plastics or rubbers will be present. | | |
| | Total cellulosics..... | 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..... | 0 | |
| Other materials (%wt): | Some graphite dust may be associated with reactor materials. | | |
| | Inorganic ion exchange materials. | 0 | |
| | Inorganic sludges and flocs..... | 0 | |
| | 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..... | 0 | |
| | Free non-aqueous liquids..... | 0 | |
| | Powder/Ash..... | 0 | |

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Inorganic anions (%wt): Trace quantities of chloride may be present.

| | |
|---|---|
| Fluoride | 0 |
| Chloride | TR |
| Iodide | 0 |
| Cyanide | 0 |
| Carbonate | 0 |
| Nitrate | 0 |
| Nitrite | 0 |
| Phosphate | 0 |
| Sulphate | 0 |
| Sulphide | 0 |

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 | |
| Other organophosphates | |
| Vinyl chloride | |
| Arsenic | |
| Barium | |

**WASTE STREAM 9E310 Stainless Steel (Reactor) ILW**

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

**PACKAGING AND CONDITIONING**

| | |
|---|---|
| Conditioning method: | The waste is not expected to be supercompacted. The treatment envisaged is the placement of the waste in baskets followed by encapsulation. |
| Plant Name: | None |
| Location: | Oldbury Power Station |
| Plant startup date: | 2096 |
| Total capacity ($m^3$/y incoming waste): | ~5000.0 |
| Target start date for packaging this stream: | 2096 |
| Throughput for this stream ($m^3$/y incoming waste): | ~14.0 |
| Other information: | The processing strategy has not yet been determined. |

Likely container type:

| Container | Waste packaged (%vol) | Waste loading ($m^3$) | Payload ($m^3$) | Number of packages |
|---|---|---|---|---|
| 4m box (200mm concrete shielding) | 100.0 | 9.3 | 10.9 | 9 |

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| | |
|---|---|
| Likely container type comment: | The container choice is based upon the upper limit of specific activity, but this may be influenced by the Transport Regulations at the time of Final Site Clearance. This could mean that a 4m box with 100mm of shielding could be used instead. The waste is assumed to be in baskets in the waste package so the occupied volume in the package is greater than the original waste volume. |
| Range in container waste volume: | Not yet determined. No significant variability is expected. |
| Other information on containers: | The container material is expected to be stainless steel. |
| Likely conditioning matrix: | Blast Furnace Slag / Ordinary Portland Cement |
| Other information: | The waste is assumed to be encapsulated. |
| Conditioned density (t/m³): | ~3.0 |
| Conditioned density comment: | The conditioned waste density assumes that the waste will be encapsulated. |
| Other information on conditioning: | The waste will be in baskets placed in the waste packages. Baskets of different Final Site Clearance ILW wastes may be in the same waste package. The encapsulation matrix is likely to be BFS/OPC and the density of the conditioned waste product would be about 3 t/m3. |
| Opportunities for alternative disposal routing: | No |

| Treatment | Stream volume (%) | Comment |
|---|---|---|
| - | - | - |

### RADIOACTIVITY

| | |
|---|---|
| Source: | Activation of the stainless steel and impurities. |
| Uncertainty: | The values quoted were derived by calculation from available material specification and are indicative of the activities that are expected. The major source of uncertainty is the impurity levels. |
| 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. All alpha emitter activities are insignificant. |
| Measurement of radioactivities: | The specific activities have been estimated using a neutron activation calculation. |
| Other information: | The activities quoted are those at 85 years after reactor shutdown. There may be some contamination by Cs137. |

## WASTE STREAM 9E310 Stainless Steel (Reactor) ILW

| Nuclide | Mean radioactivity, TBq/m³ Waste at 1.4.2019 | Bands and Code | Future arisings | Bands and Code | Nuclide | Mean radioactivity, TBq/m³ Waste at 1.4.2019 | Bands and Code | Future arisings | Bands and Code |
|---|---|---|---|---|---|---|---|---|---|
| H 3 | | | | 8 | Gd 153 | | | | 8 |
| Be 10 | | | | 8 | Ho 163 | | | | 8 |
| C 14 | | | 1.92E-02 | C C 2 | Ho 166m | | | | 8 |
| Na 22 | | | | 8 | Tm 170 | | | | 8 |
| Al 26 | | | | 8 | Tm 171 | | | | 8 |
| Cl 36 | | | 9.68E-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 | | | | 8 | Pt 193 | | | | 8 |
| Mn 53 | | | | 8 | Tl 204 | | | 6.87E-08 | C C 2 |
| Mn 54 | | | | 8 | Pb 205 | | | | 8 |
| Fe 55 | | | 2.13E-08 | C C 2 | Pb 210 | | | | 8 |
| Co 60 | | | 3.9E-04 | C C 2 | Bi 208 | | | | 8 |
| Ni 59 | | | 5.76E-02 | C C 2 | Bi 210m | | | | 8 |
| Ni 63 | | | 3.52E+00 | C C 2 | Po 210 | | | | 8 |
| Zn 65 | | | | 8 | Ra 223 | | | | 8 |
| Se 79 | | | | 8 | Ra 225 | | | | 8 |
| Kr 81 | | | | 8 | Ra 226 | | | | 8 |
| Kr 85 | | | | 8 | Ra 228 | | | | 8 |
| Rb 87 | | | | 8 | Ac 227 | | | | 8 |
| Sr 90 | | | | 8 | Th 227 | | | | 8 |
| Zr 93 | | | | 8 | Th 228 | | | | 8 |
| Nb 91 | | | | 8 | Th 229 | | | | 8 |
| Nb 92 | | | 1.62E-09 | C C 2 | Th 230 | | | | 8 |
| Nb 93m | | | | 6 | Th 232 | | | | 8 |
| Nb 94 | | | 1.21E-02 | C C 2 | Th 234 | | | | 8 |
| Mo 93 | | | 1.07E-04 | C D 2 | Pa 231 | | | | 8 |
| Tc 97 | | | | 8 | Pa 233 | | | | 8 |
| Tc 99 | | | 2.18E-05 | C C 2 | U 232 | | | | 8 |
| Ru 106 | | | | 8 | U 233 | | | | 8 |
| Pd 107 | | | | 8 | U 234 | | | | 8 |
| Ag 108m | | | 6.61E-06 | C D 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 | Pu 238 | | | | 8 |
| Sn 123 | | | | 8 | Pu 239 | | | | 8 |
| Sn 126 | | | | 8 | Pu 240 | | | | 8 |
| 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 | | | | 6 | 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 | | | | 8 | Other a | | | | |
| Eu 152 | | | | 8 | Other b/g | | | | |
| Eu 154 | | | | 8 | **Total a** | **0** | | **0** | |
| Eu 155 | | | | 8 | **Total b/g** | **0** | | **3.61E+00** | **C C 2** |

**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