## WASTE STREAM 9E959 BCD LLW

**SITE** Oldbury

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** LLW

**WASTE VOLUMES**

| | | Reported |
|---|---|---|
| Stocks: | At 1.4.2019..... | 0.7 m³ |
| Future arisings - | 1.4.2019 - 31.3.2020..... | 0.3 m³ |
| | 1.4.2020 - 31.3.2021..... | 3.9 m³ |
| | 1.4.2021 - 31.3.2022..... | 2.0 m³ |
| | 1.4.2022 - 31.3.2027..... | 7.8 m³ |
| Total future arisings: | | 13.9 m³ |
| Total waste volume: | | 14.6 m³ |

Comment on volumes: Waste in this stream is assumed to arise after defueling.

Uncertainty factors on volumes:

| | | | |
|---|---|---|---|
| Stock (upper): | x 1.1 | Arisings (upper) | x 1.2 |
| Stock (lower): | x 0.9 | Arisings (lower) | x 0.8 |

**WASTE SOURCE** Waste arising from areas associated with BCDs.

### PHYSICAL CHARACTERISTICS

General description: Mixed trash. Large items do occasionally arise. This happens infrequently and it is therefore difficult to include specific details.

Physical components (%wt): Metal (60% wt), concrete/rubble (1%), soil (1%), biodegradables (17%), plasterboard (1%), plastics (4%), rubber (2%), wood (3%), other organic (1%), others including asbestos (10%).

Sealed sources: -

Bulk density (t/m³): 0.4

Comment on density: WCH mass divided by volume

### CHEMICAL COMPOSITION

General description and components (%wt): The waste comprises metal, various plastics including polythene, paper, wood and rubber. The metals will include steel, copper and aluminium. Metal (60% wt), concrete/rubble (1%), soil (1%), biodegradables (17%), plasterboard (1%), plastics (4%), rubber (2%), wood (3%), other organic (1%), others including asbestos (10%).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Tritium is present as surface contamination of waste by tritiated liquor.
C-14: Carbon 14 may be contamination in the form of graphite dust.
Cl-36: Chlorine 36 may be present as a contaminant of graphite dust.
Se-79: The selenium 79 content is insignificant.
Tc-99: The technetium 99 content is insignificant.
Ra: The radium isotope content is insignificant.
Th: The thorium content is insignificant.
U: Chemical form of uranium isotopes has not been determined but may be uranium oxides.
Np: The neptunium isotope content is insignificant.
Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Thicknesses of metal may vary from 1 mm to 30 mm.

| | | |
|---|---|---|
| Stainless steel..... | ~2.8 | pipework,pumps,motors,cabinets |
| Other ferrous metals..... | ~55.5 | mild steel - pipework,pumps,motors,cabinets |
| Iron..... | ~1.5 | |
| Aluminium..... | TR | |
| Beryllium..... | | |
| Cobalt..... | | |

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|---|---|---|---|
| | Copper | ~0.17 | |
| | Lead | 0 | |
| | Magnox/Magnesium | TR | Magnox may be present in trace quantities, but will not consitute a hazard |
| | Nickel | | |
| | Titanium | | |
| | Uranium | | |
| | Zinc | 0.17 | Trace (in galvanised steel) |
| | Zircaloy/Zirconium | 0 | |
| | Other metals | 0 | Mass estimates in the table above for mild steel and stainless steel include the constituent alloying elements such as Cr, Fe, Ni and Co. Therefore, these constituent alloying elements are not recorded seperately to avoid double accounting. |
| Organics (%wt): | - | | |
| | Total cellulosics | 3.0 | |
| | Paper, cotton | 0 | |
| | Wood | 3.0 | |
| | Halogenated plastics | ~0.80 | PVC, PPE |
| | Total non-halogenated plastics | ~3.3 | |
| | Condensation polymers | ~1.7 | pipes,ply,PPE,perspex,containers, sheet and hoses |
| | Others | ~1.7 | pipes,ply,PPE,perspex,containers, sheet and hoses |
| | Organic ion exchange materials | 0 | |
| | Total rubber | ~2.0 | |
| | Halogenated rubber | ~1.0 | neoprene |
| | Non-halogenated rubber | ~1.0 | |
| | Hydrocarbons | | |
| | Oil or grease | | |
| | Fuel | | |
| | Asphalt/Tarmac (cont.coal tar) | | |
| | Asphalt/Tarmac (no coal tar) | | |
| | Bitumen | | |
| | Others | | |
| | Other organics | ~1.0 | |
| Other materials (%wt): | - | | |
| | Inorganic ion exchange materials. | 0 | |
| | Inorganic sludges and flocs | 0 | |
| | Soil | ~1.0 | |
| | Brick/Stone/Rubble | ~1.0 | |
| | Cementitious material | 0 | |
| | Sand | | |

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|---|---|---|---|
| | Glass/Ceramics | 10.0 | includes 0.17% MMMF Laggging (associated with general plant items) |
| | Graphite | TR | |
| | Desiccants/Catalysts | | |
| | Asbestos | ~0.17 | |
| | Non/low friable | 0 | |
| | Moderately friable | 0 | |
| | Highly friable | ~0.17 | Lagging / gaskets - chrysotile (white) |
| | Free aqueous liquids | 0 | |
| | Free non-aqueous liquids | 0 | |
| | Powder/Ash | 0 | |
| Inorganic anions (%wt): | None present. | | |
| | Fluoride | 0 | |
| | Chloride | 0 | |
| | Iodide | 0 | |
| | Cyanide | 0 | |
| | Carbonate | 0 | |
| | Nitrate | 0 | |
| | Nitrite | 0 | |
| | Phosphate | 0 | |
| | Sulphate | 0 | |
| | Sulphide | 0 | |
| Materials of interest for waste acceptance criteria: | Trace of Magnox may be present but will not constitute a hazard. | | |
| | Combustible metals | 0 | |
| | Low flash point liquids | 0 | |
| | Explosive materials | 0 | |
| | Phosphorus | 0 | |
| | Hydrides | 0 | |
| | Biological etc. materials | 0 | |
| | Biodegradable materials | 17.0 | |
| | Putrescible wastes | ~1.0 | |
| | Non-putrescible wastes | ~16.0 | |
| | Corrosive materials | 0 | |
| | Pyrophoric materials | 0 | |
| | Generating toxic gases | 0 | |
| | Reacting with water | 0 | |
| | Active particles | | |
| | Soluble solids as bulk chemical compounds | | |

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Hazardous substances / non hazardous pollutants: -

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

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..... | P | 10 off Electronic panels and test equipment |
| EEE Type 2..... | P | 5 off Electronic motors and pumps |
| EEE Type 3..... | P | 10 off Electrical power tools |
| EEE Type 4..... | P | 5 off Fluorescent tubes / lamps |
| EEE Type 5..... | P | 1 off Rechargeable batteries, Nickel-Cadmium/Lithium-Ion |

Complexing agents (%wt): No

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... 0

**WASTE STREAM 9E959 BCD LLW**

**TREATMENT, PACKAGING AND DISPOSAL**

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

| Treatment | On-site / Off site | Stream volume % |
|---|---|---|
| Low force compaction | On-site | 32.0 |
| Supercompaction (HFC) | Off-site | 32.0 |
| Incineration | | |
| Solidification | | |
| Decontamination | | |
| Metal treatment | Off-site | 35.0 |
| Size reduction | | |
| Decay storage | | |
| Recyling / reuse | | |
| Other / various | | |
| None | | 33.0 |

Comment on planned treatments: 35% of this waste stream is expected to be sent for Metal Recycle.

**Disposal Routes:**

| Disposal Route | Stream volume % |
|---|---|
| Expected to be consigned to the LLW Repository | 65.0 |
| Expected to be consigned to a Landfill Facility | |
| Expected to be consigned to an On-Site Disposal Facility | |
| Expected to be consigned to an Incineration Facility | |
| Expected to be consigned to a Metal Treatment Facility | 35.0 |
| Expected to be consigned as Out of Scope | |
| Expected to be recycled / reused | |
| Disposal route not known | |

**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 | | | |
| Expected to be consigned to a Landfill Facility | | | |
| Expected to be consigned to an On-Site Disposal Facility | | | |
| Expected to be consigned to an Incineration Facility | | | |
| Expected to be consigned to a Metal Treatment Facility | | | |
| Expected to be consigned as Out of Scope | | | |
| Expected to be recycled / reused | | | |
| Disposal route not known | | | |

**Waste Packaging for Disposal:**

| Container | Stream volume % | Waste loading $m^3$ | Number of packages |
|---|---|---|---|
| 1/3 Height IP-1 ISO | | | |
| 2/3 Height IP-2 ISO | | | |
| 1/2 Height WAMAC IP-2 ISO | 32.0 | ~43.2 | < 1 |
| 1/2 Height IP-2 Disposal/Re-usable ISO | 33.0 | ~10 | < 1 |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other | | | |

Other information: 43.2m3 loading volume is calculated based on the fact that you can low force compact two times the normal volume of waste into a 200 litre/0.2m3 drum (400 litres/0.4m3), you can then fit 36 drums (14.4m3) into a ½ height ISO, each drum can be super-compacted to a 1/3 of its original volume so therefore we can get 3 x the amount of un-compacted drums into the final disposal container (43.2m3).

## WASTE STREAM 9E959 BCD LLW

**Waste Planned for Disposal at the LLW Repository:**

| | |
|---|---|
| Container voidage: | - |
| Waste Characterisation Form (WCH): | The waste meets the LLWR's Waste Acceptance Criteria (WAC).<br>The waste has a current WCH. |
| Waste consigned for disposal to LLWR in year of generation: | Yes. |
| 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

| | |
|---|---|
| Source: | Principal constituents are activation products arising from dry fuel routes. Waste also contains fission products and actinides. |
| Uncertainty: | Specific activity is a function of Station operating history. The values quoted are indicative of the activities that would be expected. |
| Definition of total alpha and total beta/gamma: | Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'. |
| Measurement of radioactivities: | Data taken from WCH - 1MXN-3OLD-0-WCH-0-3925 V5 decayed by two years for RWI 2019 |
| Other information: | - |

## WASTE STREAM 9E959 BCD LLW

| Nuclide | Mean radioactivity, TBq/m³ | | | | Nuclide | Mean radioactivity, TBq/m³ | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 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 | 2.78E-03 | C C 1 | 2.78E-03 | C C 1 | Gd 153 | | 8 | | 8 |
| Be 10 | | 8 | | 8 | Ho 163 | | 8 | | 8 |
| C 14 | 1.42E-04 | C C 1 | 1.42E-04 | C C 1 | Ho 166m | | 8 | | 8 |
| Na 22 | | 8 | | 8 | Tm 170 | | 8 | | 8 |
| Al 26 | | 8 | | 8 | Tm 171 | | 8 | | 8 |
| Cl 36 | 2.95E-05 | C C 1 | 2.95E-05 | C C 1 | Lu 174 | | 8 | | 8 |
| Ar 39 | | 8 | | 8 | Lu 176 | | 8 | | 8 |
| Ar 42 | | 8 | | 8 | Hf 178n | | 8 | | 8 |
| K 40 | | 8 | | 8 | Hf 182 | | 8 | | 8 |
| Ca 41 | | 8 | | 8 | Pt 193 | | 8 | | 8 |
| Mn 53 | | 8 | | 8 | Tl 204 | | 8 | | 8 |
| Mn 54 | 3.02E-09 | C C 2 | 3.02E-09 | C C 2 | Pb 205 | | 8 | | 8 |
| Fe 55 | 1.67E-06 | C C 1 | 1.67E-06 | C C 1 | Pb 210 | | 8 | | 8 |
| Co 60 | 2.71E-06 | C C 2 | 2.71E-06 | C C 2 | Bi 208 | | 8 | | 8 |
| Ni 59 | | 8 | | 8 | Bi 210m | | 8 | | 8 |
| Ni 63 | 4.63E-06 | C C 1 | 4.63E-06 | C C 1 | Po 210 | | 8 | | 8 |
| Zn 65 | 1.6E-09 | C C 2 | 1.6E-09 | C C 2 | Ra 223 | | 8 | | 8 |
| Se 79 | | 8 | | 8 | Ra 225 | | 8 | | 8 |
| Kr 81 | | 8 | | 8 | Ra 226 | | 8 | | 8 |
| Kr 85 | | 8 | | 8 | Ra 228 | | 8 | | 8 |
| Rb 87 | | 8 | | 8 | Ac 227 | | 8 | | 8 |
| Sr 90 | 4.34E-06 | C C 1 | 4.34E-06 | C C 1 | Th 227 | | 8 | | 8 |
| Zr 93 | | 8 | | 8 | Th 228 | | 8 | | 8 |
| Nb 91 | | 8 | | 8 | Th 229 | | 8 | | 8 |
| Nb 92 | | 8 | | 8 | Th 230 | | 8 | | 8 |
| Nb 93m | | 8 | | 8 | Th 232 | | 8 | | 8 |
| Nb 94 | 1.03E-06 | C C 2 | 1.03E-06 | C C 2 | Th 234 | 2.33E-08 | C C 2 | 2.33E-08 | C C 2 |
| Mo 93 | | 8 | | 8 | Pa 231 | | 8 | | 8 |
| Tc 97 | | 8 | | 8 | Pa 233 | | 8 | | 8 |
| Tc 99 | | 8 | | 8 | U 232 | | 8 | | 8 |
| Ru 106 | 6.72E-08 | C C 2 | 6.72E-08 | C C 2 | U 233 | | 8 | | 8 |
| Pd 107 | | 8 | | 8 | U 234 | 2E-08 | C C 1 | 2E-08 | C C 1 |
| Ag 108m | 1.02E-06 | C C 2 | 1.02E-06 | C C 2 | U 235 | | 8 | | 8 |
| Ag 110m | | 8 | | 8 | U 236 | 2.67E-09 | C C 1 | 2.67E-09 | C C 1 |
| Cd 109 | | 8 | | 8 | U 238 | 2.33E-08 | C C 1 | 2.33E-08 | C C 1 |
| Cd 113m | | 8 | | 8 | Np 237 | | 8 | | 8 |
| Sn 119m | | 8 | | 8 | Pu 236 | | 8 | | 8 |
| Sn 121m | | 8 | | 8 | Pu 238 | 4.4E-08 | C C 1 | 4.4E-08 | C C 1 |
| Sn 123 | | 8 | | 8 | Pu 239 | 1.27E-08 | C C 1 | 1.27E-08 | C C 1 |
| Sn 126 | | 8 | | 8 | Pu 240 | 1.76E-08 | C C 1 | 1.76E-08 | C C 1 |
| Sb 125 | 5.56E-07 | C C 2 | 5.56E-07 | C C 2 | Pu 241 | 4.57E-06 | C C 1 | 4.57E-06 | C C 1 |
| Sb 126 | | 8 | | 8 | Pu 242 | | 8 | | 8 |
| Te 125m | 1.39E-07 | C C 2 | 1.39E-07 | C C 2 | Am 241 | 2.23E-06 | C C 1 | 2.23E-06 | C C 1 |
| Te 127m | | 8 | | 8 | Am 242m | | 8 | | 8 |
| I 129 | | 8 | | 8 | Am 243 | | 8 | | 8 |
| Cs 134 | 8.43E-08 | C C 2 | 8.43E-08 | C C 2 | Cm 242 | | 8 | | 8 |
| Cs 135 | | 8 | | 8 | Cm 243 | 5.73E-08 | C C 1 | 5.73E-08 | C C 1 |
| Cs 137 | 4.56E-06 | C C 2 | 4.56E-06 | C C 2 | Cm 244 | 1.38E-06 | C C 1 | 1.38E-06 | C C 1 |
| Ba 133 | 7.36E-07 | C C 2 | 7.36E-07 | C C 2 | Cm 245 | | 8 | | 8 |
| La 137 | | 8 | | 8 | Cm 246 | | 8 | | 8 |
| La 138 | | 8 | | 8 | Cm 248 | | 8 | | 8 |
| Ce 144 | 8.91E-09 | C C 2 | 8.91E-09 | C C 2 | Cf 249 | | 8 | | 8 |
| Pm 145 | | 8 | | 8 | Cf 250 | | 8 | | 8 |
| Pm 147 | 1.93E-06 | C C 1 | 1.93E-06 | C C 1 | Cf 251 | | 8 | | 8 |
| Sm 147 | | 8 | | 8 | Cf 252 | | 8 | | 8 |
| Sm 151 | | 8 | | 8 | Other a | | | | |
| Eu 152 | 1.91E-06 | C C 2 | 1.91E-06 | C C 2 | Other b/g | | | | |
| Eu 154 | 2.02E-06 | C C 2 | 2.02E-06 | C C 2 | **Total a** | **3.79E-06** | **C C 2** | **3.79E-06** | **C C 2** |
| Eu 155 | 1.28E-06 | C C 2 | 1.28E-06 | C C 2 | **Total b/g** | **2.98E-03** | **C C 2** | **2.98E-03** | **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