## WASTE STREAM 9E958 Dry Fuel Route (excluding BCD) LLW

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

**WASTE VOLUMES**

| | | Reported |
|---|---|---|
| Stocks: | At 1.4.2019..... | 4.7 m³ |
| Future arisings - | 1.4.2019 - 31.3.2020..... | 10.5 m³ |
| | 1.4.2020 - 31.3.2021..... | 45.7 m³ |
| | 1.4.2021 - 31.3.2022..... | 22.8 m³ |
| | 1.4.2022 - 31.3.2027..... | 91.4 m³ |
| Total future arisings: | | 170.4 m³ |
| Total waste volume: | | 175.1 m³ |
| Comment on volumes: | - | |
| Uncertainty factors on volumes: | Stock (upper): x 1.2 | Arisings (upper) x 1.2 |
| | Stock (lower): x 0.8 | Arisings (lower) x 0.8 |

**WASTE SOURCE** Waste arising from areas associated with pile cap, pressure vessel, maintenance cells, circulators, circulator plant workshop, circulator oil filtration plant, fuel loading well, boiler internals and contaminated plant workshops

### PHYSICAL CHARACTERISTICS

| | |
|---|---|
| General description: | The waste consists mostly of mixed trash and demolition wastes. Large items do occasionally arise. This happens infrequently and it is therefore difficult to include specific details. Any items will be cut to fit standard packages. |
| Physical components (%wt): | Metal (~48%wt), concrete (~9%wt), soil (~4% wt), biodegradables (~5%), plasterboard (~1%), plastic (4%wt), rubber (~4%), wood (~4%), other organic (~1%), others oil and asbestos (~20%). |
| Sealed sources: | - |
| Bulk density (t/m³): | ~0.4 |
| Comment on density: | The density is of the waste as cut for packaging. WCH mass divided by volume. |

### CHEMICAL COMPOSITION

| | |
|---|---|
| General description and components (%wt): | The waste comprises metal, cables (Cu), asbestos insulation, MMMF (Man Made Mineral fibre), concrete and general waste. The metals will include steel, stainless steel, copper cables, switch gear and light iron ductwork. Metal (~48%wt), concrete (~9%wt), soil (~4% wt), biodegradables (~5%), plasterboard (~1%), plastic (4%wt), rubber (~4%), wood (~4%), other organic (~1%), others oil and asbestos (~20%). |
| Chemical state: | Neutral |
| Chemical form of radionuclides: | H-3: Tritium present as surface contamination of waste by tritiated water.<br>C-14: Carbon 14 may be present as contamination in the form of graphite dust.<br>Cl-36: Chlorine 36 may be present as a contaminant of graphite dust.<br>Se-79: The selenium content is insignificant.<br>Tc-99: The technetium content is insignificant.<br>Ra: The radium isotope content is insignificant.<br>Th: The thorium content is insignificant.<br>U: The chemical form of uranium isotopes has not been determined but may be uranium oxides.<br>Np: The neptunium content is insignificant.<br>Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides. |
| Metals and alloys (%wt): | Metal thickness may vary from 1 mm to 30 mm. |

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|---|---|---|---|
| | Stainless steel | ~6.7 | pipework, tanks,motors and pumps |
| | Other ferrous metals | ~39.9 | mild steel - pipework,tanks, motors and pumps |
| | Iron | 0.83 | |
| | Aluminium | 0.28 | |
| | Beryllium | 0 | |
| | Cobalt | | |
| | Copper | ~0.10 | |
| | Lead | 0.28 | sheet, pipe,block and shot |
| | Magnox/Magnesium | TR | Magnox may be present in trace quantities, but will not consitute a hazard |
| | Nickel | | |
| | Titanium | | |
| | Uranium | | |
| | Zinc | 0.05 | Trace (in galvanised steel) |
| | Zircaloy/Zirconium | TR | |
| | Other metals | 0 | "Other" metals have not been identified. |
| Organics (%wt): | - | | |
| | Total cellulosics | ~4.0 | |
| | Paper, cotton | 0 | |
| | Wood | ~4.0 | |
| | Halogenated plastics | ~2.0 | PVC,PPE |
| | Total non-halogenated plastics | 2.0 | |
| | Condensation polymers | 1.0 | pipes,poly,ppe,perspex,containers, sheet and hoses |
| | Others | 1.0 | pipes,poly,ppe,perspex,containers, sheet and hoses |
| | Organic ion exchange materials | 0 | |
| | Total rubber | ~4.0 | |
| | Halogenated rubber | ~2.0 | neoprene |
| | Non-halogenated rubber | ~2.0 | |
| | Hydrocarbons | ~20.1 | |
| | Oil or grease | ~20.0 | Radioactive oil |
| | Fuel | | |
| | Asphalt/Tarmac (cont.coal tar) | | |
| | Asphalt/Tarmac (no coal tar) | ~0.06 | road surface |
| | Bitumen | | |
| | Others | | |
| | Other organics | ~1.0 | |
| Other materials (%wt): | - | | |

| | | | |
|---|---|---|---|
| | Inorganic ion exchange materials. | 0 | |
| | Inorganic sludges and flocs..... | 0 | |
| | Soil..... | 4.0 | |
| | Brick/Stone/Rubble..... | 9.0 | |
| | Cementitious material..... | | |
| | Sand..... | | |
| | Glass/Ceramics..... | 0.03 | MMMF Lagging (associated with general plant items) |
| | Graphite..... | TR | |
| | Desiccants/Catalysts..... | | |
| | Asbestos..... | ~0.03 | |
| | Non/low friable..... | 0 | |
| | Moderately friable..... | 0 | |
| | Highly friable..... | ~0.03 | Lagging / gaskets chrysotile (white) |
| | Free aqueous liquids..... | 0 | |
| | Free non-aqueous liquids..... | 0 | |
| | Powder/Ash..... | 0 | |
| Inorganic anions (%wt): | None expected, but possibly present in trace quantities. | | |
| | 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: | Magnox may be present in trace quantities but will not constitute a hazard. Some Asbestos and MMMF is expected to be present. | | |
| | Combustible metals..... | 0 | |
| | Low flash point liquids..... | 0 | |
| | Explosive materials..... | 0 | |
| | Phosphorus..... | 0 | |
| | Hydrides..... | 0 | |
| | Biological etc. materials..... | TR | |
| | Biodegradable materials..... | ~5.0 | |
| | Putrescible wastes..... | ~1.0 | |
| | Non-putrescible wastes..... | ~4.0 | |
| | Corrosive materials..... | 0 | |
| | Pyrophoric materials..... | 0 | |
| | Generating toxic gases..... | 0 | |
| | Reacting with water..... | 0 | |

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|---|---|---|

Active particles.....

Soluble solids as bulk chemical compounds.....

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 | 15 off Electronic panels and test equipment |
| EEE Type 2..... | P | 25 off Electronic motors and pumps |
| EEE Type 3..... | P | 20 off Electrical power tools |
| EEE Type 4..... | P | 25 off Fluorescent tubes / lamps |
| EEE Type 5..... | P | 3 off Rechargeable batteries, Nickel-Cadmium/Lithium-Ion |

Complexing agents (%wt): No

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... 0

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**TREATMENT, PACKAGING AND DISPOSAL**

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

| Treatment | On-site / Off site | Stream volume % |
|---|---|---|
| Low force compaction | On-site | 5.0 |
| Supercompaction (HFC) | Off-site | 5.0 |
| Incineration | Off-site | 80.0 |
| Solidification | | |
| Decontamination | | |
| Metal treatment | Off-site | 10.0 |
| Size reduction | | |
| Decay storage | | |
| Recyling / reuse | | |
| Other / various | | |
| None | | 5.0 |

Comment on planned treatments: 10% 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 | 10.0 |
| 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 | 80.0 |
| Expected to be consigned to a Metal Treatment Facility | 10.0 |
| 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 | 5.0 | 43.2 | < 1 |
| 1/2 Height IP-2 Disposal/Re-usable ISO | 5.0 | 10 | < 1 |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other | | | |

Other information: It is likely that this waste will be placed in a container with other LLW. 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 Planned for Disposal at the LLW Repository:**

| | |
|---|---|
| Container voidage: | No significant inaccessible voidage is expected. |
| 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: | Activation and contamination of materials. |
| Uncertainty: | Activity values are current best estimates. Specific activity is a function of Station operating history. The values quoted are indicative of the activities that would be expected, although demolition wastes are predicted to be lower in activity than the routine operational wastes and so the values quoted for this stream are expected to be an over estimate. |
| 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-0-3924 V5 decayed by two years for RWI 2019 |
| Other information: | - |

## WASTE STREAM 9E958 Dry Fuel Route (excluding 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 | 2.88E-04 | C C 1 | 2.88E-04 | C C 1 | Gd 153 | | 8 | | 8 |
| Be 10 | | 8 | | 8 | Ho 163 | | 8 | | 8 |
| C 14 | 4.61E-05 | C C 1 | 4.61E-05 | 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 | 6.89E-06 | C C 1 | 6.89E-06 | 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 | 7.57E-09 | C C 2 | 7.57E-09 | C C 2 | Pb 205 | | 8 | | 8 |
| Fe 55 | 8.61E-05 | C C 1 | 8.61E-05 | C C 1 | Pb 210 | | 8 | | 8 |
| Co 60 | 2.45E-05 | C C 2 | 2.45E-05 | C C 2 | Bi 208 | | 8 | | 8 |
| Ni 59 | | 8 | | 8 | Bi 210m | | 8 | | 8 |
| Ni 63 | 4.52E-06 | C C 1 | 4.52E-06 | C C 1 | Po 210 | | 8 | | 8 |
| Zn 65 | 2.3E-09 | C C 2 | 2.3E-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 | 1.26E-06 | C C 1 | 1.26E-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 | 4.88E-07 | C C 2 | 4.88E-07 | C C 2 | Th 234 | | 8 | | 8 |
| 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 | 3.67E-08 | C C 2 | 3.67E-08 | C C 2 | U 233 | | 8 | | 8 |
| Pd 107 | | 8 | | 8 | U 234 | | 8 | | 8 |
| Ag 108m | 4.89E-07 | C C 2 | 4.89E-07 | C C 2 | U 235 | | 8 | | 8 |
| Ag 110m | | 8 | | 8 | U 236 | | 8 | | 8 |
| Cd 109 | | 8 | | 8 | U 238 | | 8 | | 8 |
| Cd 113m | | 8 | | 8 | Np 237 | | 8 | | 8 |
| Sn 119m | | 8 | | 8 | Pu 236 | | 8 | | 8 |
| Sn 121m | | 8 | | 8 | Pu 238 | 1.28E-08 | C C 1 | 1.28E-08 | C C 1 |
| Sn 123 | | 8 | | 8 | Pu 239 | 5.11E-09 | C C 1 | 5.11E-09 | C C 1 |
| Sn 126 | | 8 | | 8 | Pu 240 | 6.67E-09 | C C 1 | 6.67E-09 | C C 1 |
| Sb 125 | 2.59E-07 | C C 2 | 2.59E-07 | C C 2 | Pu 241 | 1.53E-06 | C C 1 | 1.53E-06 | C C 1 |
| Sb 126 | | 8 | | 8 | Pu 242 | | 8 | | 8 |
| Te 125m | 6.48E-08 | C C 2 | 6.48E-08 | C C 2 | Am 241 | 6.39E-08 | C C 1 | 6.39E-08 | C C 1 |
| Te 127m | | 8 | | 8 | Am 242m | | 8 | | 8 |
| I 129 | | 8 | | 8 | Am 243 | | 8 | | 8 |
| Cs 134 | 6.75E-08 | C C 2 | 6.75E-08 | C C 2 | Cm 242 | | 8 | | 8 |
| Cs 135 | | 8 | | 8 | Cm 243 | | 8 | | 8 |
| Cs 137 | 1.14E-06 | C C 2 | 1.14E-06 | C C 2 | Cm 244 | 1.89E-08 | C C 1 | 1.89E-08 | C C 1 |
| Ba 133 | 2.21E-07 | C C 2 | 2.21E-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 | 6.7E-09 | C C 2 | 6.7E-09 | C C 2 | Cf 249 | | 8 | | 8 |
| Pm 145 | | 8 | | 8 | Cf 250 | | 8 | | 8 |
| Pm 147 | 5.19E-08 | C C 1 | 5.19E-08 | C C 1 | Cf 251 | | 8 | | 8 |
| Sm 147 | | 8 | | 8 | Cf 252 | | 8 | | 8 |
| Sm 151 | | 8 | | 8 | Other a | | | | |
| Eu 152 | 1.16E-06 | C C 2 | 1.16E-06 | C C 2 | Other b/g | | | | |
| Eu 154 | 6.49E-07 | C C 2 | 6.49E-07 | C C 2 | **Total a** | **1.07E-07** | **C C 2** | **1.07E-07** | **C C 2** |
| Eu 155 | 4.88E-07 | C C 2 | 4.88E-07 | C C 2 | **Total b/g** | **4.64E-04** | **C C 2** | **4.64E-04** | **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