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| WASTE STREAM | 9G107/C | Ion Exchange Material |
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|------------------------------------|--|----------------------|----------------------|
| SITE | Trawsfynydd | | |
| SITE OWNER | Nuclear Decommissioning Authority | | |
| WASTE CUSTODIAN | Magnox Limited | | |
| WASTE TYPE | ILW | | |
| WASTE VOLUMES | | Conditioned | Packaged |
| Stocks: | At 1.4.2019..... | 103.8 m ³ | 453.9 m ³ |
| Total future arisings: | | 0 m ³ | 0 m ³ |
| Total waste volume: | | 103.8 m ³ | 453.9 m ³ |
| Number of waste packages in stock: | At 1.4.2019..... | 136 package(s) | |
| Comment on volumes: | No future arisings. 136 x 1803 type drums are currently in stock. It is assumed 6 drums will be packaged into a 4m ³ box at the time of disposal. | | |
| Uncertainty factors on volumes: | Stock (upper): x 1.0 | Arisings (upper) | x |
| | Stock (lower): x 1.0 | Arisings (lower) | x |
| WASTE SOURCE | Ion exchange materials retrieved from storage tanks (resin vault 3) and solidified in the solidification plant at Trawsfynydd (campaign 8). | | |

PHYSICAL CHARACTERISTICS

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|-----------------------------------|---|--|--|
| General description: | Conditioned ion exchange material in packages originally intended for sea dumping. The packages (136) are type 1803C. Drums are 0.9 m diameter x 1.2 m high and contain approximately 0.3 m ³ of conditioned ion exchange material. The packages each weigh about 2.5 t and so require suitable lifting equipment. | | |
| Physical components (%vol): | Ion exchange material (5.7% wt), polymer and iron grit (6.6% wt), water (2.4 % wt), mild steel (1.7% wt), iron shot (74.8% wt), cement paste/grout (8.8% wt). | | |
| Sealed sources: | - | | |
| Bulk density (t/m ³): | ~3.2 | | |
| Comment on density: | Density of waste is 1.2 t/m ³ . Density of packaged waste is 3.2 t/m ³ . | | |

CHEMICAL COMPOSITION

| | | | |
|---|---|--|--|
| General description and components (%wt): | The ion exchange material which is contaminated with both fission products and actinides, has been conditioned by mixing with DOW WSB 101 polymer. Packaging and conditioning was carried out with a neoprene rubber gasket being incorporated into each drum. On average each package contains proprietary ion exchange materials (including a little sand) (5.7% wt), iron grit and DOW polymer (6.6% wt), water (2.4% wt), mild steel (1.7% wt), iron shot (74.8% wt), cement paste/grout (8.8% wt). Ion exchange material types: Proprietary ion exchange material including mainly Lewatit DN and AW500, the remainder consists of IRA 74, ARC 359, IE95, IRN78L and cation resin. At least 32% of the ion exchange resins are organic in nature (principally phenol formaldehyde based). The remainder are inorganic materials. | | |
| Chemical state: | Neutral | | |
| Chemical form of radionuclides: | <p>H-3: The chemical form of tritium is likely to be water but may be inorganic compounds or organic compounds.</p> <p>C-14: The chemical form of carbon 14 has not been determined.</p> <p>Se-79: The chemical form of selenium has not been determined.</p> <p>Tc-99: The chemical form of technetium has not been determined.</p> <p>Ra: The radium isotope content is insignificant.</p> <p>Th: The thorium isotope content is insignificant.</p> <p>U: The chemical form of uranium isotopes has not been determined but may be uranium oxides.</p> <p>Np: The chemical form of neptunium has not been determined.</p> <p>Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.</p> | | |
| Metals and alloys (%wt): | Mild steel liners and reinforcing bars are present. | | |

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|------------------------|--|------|---|
| | Stainless steel..... | 0 | |
| | Other ferrous metals..... | 1.7 | |
| | Iron..... | 75.3 | Consists of iron shot (74.8 wt%) and iron grit (0.5wt%). |
| | Aluminium..... | 0 | |
| | Beryllium..... | | |
| | Cobalt..... | | |
| | Copper..... | | |
| | Lead..... | | |
| | Magnox/Magnesium..... | | |
| | Nickel..... | | |
| | Titanium..... | | |
| | Uranium..... | | |
| | Zinc..... | | |
| | Zircaloy/Zirconium..... | | |
| | Other metals..... | | |
| Organics (%wt): | Proprietary ion exchange resins which are organic in nature. | | |
| | Total cellulose..... | 0 | |
| | Paper, cotton..... | 0 | |
| | Wood..... | 0 | |
| | Halogenated plastics | 0 | |
| | Total non-halogenated plastics..... | 6.1 | |
| | Condensation polymers..... | ~6.1 | |
| | Others..... | 0 | |
| | Organic ion exchange materials.... | ~1.9 | |
| | Total rubber..... | TR | |
| | Halogenated rubber | TR | neoprene |
| | 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): | - | | |
| | Inorganic ion exchange materials. | ~3.8 | |
| | Inorganic sludges and flocs..... | NE | |
| | Soil..... | 0 | |
| | Brick/Stone/Rubble..... | 0 | |
| | Cementitious material..... | ~8.8 | |
| | Sand..... | | |

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|--|--|-------|
| | Glass/Ceramics..... | 0 |
| | Graphite..... | 0 |
| | Desiccants/Catalysts..... | |
| | Asbestos..... | 0 |
| | Non/low friable..... | |
| | Moderately friable..... | |
| | Highly friable..... | |
| | Free aqueous liquids..... | ~2.4 |
| | Free non-aqueous liquids..... | TR |
| | Powder/Ash..... | 0 |
| Inorganic anions (%wt): | - | |
| | Fluoride..... | 0 |
| | Chloride..... | |
| | Iodide..... | 0 |
| | Cyanide..... | 0 |
| | Carbonate..... | |
| | Nitrate..... | 0 |
| | Nitrite..... | 0 |
| | Phosphate..... | 0 |
| | Sulphate..... | ~0.10 |
| | Sulphide..... | 0 |
| Materials of interest for waste acceptance criteria: | - | |
| | 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..... | |

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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.....
 EEE Type 2.....
 EEE Type 3.....
 EEE Type 4.....
 EEE Type 5.....
 Complexing agents (%wt): No
 EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

PACKAGING AND CONDITIONING

| Container type: | Container | Waste packaged (%vol) | Waste loading (m ³) | Payload (m ³) | Number of packages |
|-----------------|-----------------------------------|-----------------------|---------------------------------|---------------------------|--------------------|
| | 4m box (200mm concrete shielding) | 100.0 | 4.58 | 10.9 | 23 |

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| Container type comment: | The loading volume assumes 6 type 1803 drums can be placed in a 4m ILW box. |
| Range in container waste volume: | Variability in waste loading is not expected to vary significantly. |
| Other information on containers: | The 1803 drum will be made of mild steel. A 4m ILW box would be made of stainless steel. If the waste is LLW, 200 litre drums will be used to package the waste; these are made from mild steel. |
| Conditioned density (t/m ³): | ~2.5 |
| Conditioned density comment: | The density of the wasteform is estimated to be approximately 2.5 t/m ³ . The wasteform is taken as being 6 type 1803 drums conditioned in the available volume in a 4m box. |
| Other information on conditioning: | Packaging of the drums in 4m boxes is not expected to take place until the waste is to be sent to a repository. |

RADIOACTIVITY

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|---|---|
| Source: | Spent ion exchange resins arising from the treatment of pond and effluent water. Some filter materials. Contamination by fission products, actinides and activation products. |
| Uncertainty: | Specific activity is a function of Station operating history. The values quoted are indicative of the activities that might 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: | Values were derived by extrapolation from available measurements. |
| Other information: | - |

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| Nuclide | Mean radioactivity, TBq/m ³ | | | | Nuclide | Mean radioactivity, TBq/m ³ | | | |
|---------|--|----------------|-----------------|----------------|------------------|--|----------------|-----------------|----------------|
| | 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 | 4.41E-07 | CC 2 | | | Gd 153 | | 8 | | |
| Be 10 | | 8 | | | Ho 163 | | 8 | | |
| C 14 | 3.93E-07 | CC 2 | | | Ho 166m | | 8 | | |
| Na 22 | | 8 | | | Tm 170 | | 8 | | |
| Al 26 | | 8 | | | Tm 171 | | 8 | | |
| Cl 36 | 5.18E-08 | CC 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 | | 8 | | |
| Mn 54 | | 8 | | | Pb 205 | | 8 | | |
| Fe 55 | 4.46E-08 | CC 2 | | | Pb 210 | | 8 | | |
| Co 60 | 1.79E-07 | CC 2 | | | Bi 208 | | 8 | | |
| Ni 59 | | 8 | | | Bi 210m | | 8 | | |
| Ni 63 | 2.06E-06 | CC 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 | 2.28E-02 | CC 2 | | | Th 227 | | 8 | | |
| Zr 93 | | 8 | | | Th 228 | | 8 | | |
| Nb 91 | | 8 | | | Th 229 | | 8 | | |
| Nb 92 | | 8 | | | Th 230 | | 8 | | |
| Nb 93m | | 8 | | | Th 232 | | 8 | | |
| Nb 94 | | 8 | | | Th 234 | | 8 | | |
| Mo 93 | | 8 | | | Pa 231 | | 8 | | |
| Tc 97 | | 8 | | | Pa 233 | | 8 | | |
| Tc 99 | 2.42E-05 | CC 2 | | | U 232 | | 8 | | |
| Ru 106 | | 8 | | | U 233 | | 8 | | |
| Pd 107 | | 8 | | | U 234 | 7.02E-08 | CC 2 | | |
| Ag 108m | | 8 | | | U 235 | 1.23E-08 | CC 2 | | |
| Ag 110m | | 8 | | | U 236 | | 8 | | |
| Cd 109 | | 8 | | | U 238 | 1.21E-07 | CC 2 | | |
| Cd 113m | | 8 | | | Np 237 | | 8 | | |
| Sn 119m | | 8 | | | Pu 236 | | 8 | | |
| Sn 121m | | 8 | | | Pu 238 | 1.28E-05 | CC 2 | | |
| Sn 123 | | 8 | | | Pu 239 | 3.54E-05 | CC 2 | | |
| Sn 126 | | 8 | | | Pu 240 | 4.42E-05 | CC 2 | | |
| Sb 125 | 3.46E-08 | CC 2 | | | Pu 241 | 5.86E-04 | CC 2 | | |
| Sb 126 | | 8 | | | Pu 242 | | 8 | | |
| Te 125m | | 8 | | | Am 241 | 1.39E-04 | CC 2 | | |
| Te 127m | | 8 | | | Am 242m | | 8 | | |
| I 129 | 1.62E-08 | CC 2 | | | Am 243 | | 8 | | |
| Cs 134 | 3.26E-07 | CC 2 | | | Cm 242 | | 8 | | |
| Cs 135 | | 8 | | | Cm 243 | 4.62E-08 | CC 2 | | |
| Cs 137 | 2.03E-01 | CC 2 | | | Cm 244 | 7.36E-07 | CC 2 | | |
| 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 | 2.79E-07 | CC 2 | | | Cf 251 | | 8 | | |
| Sm 147 | | 8 | | | Cf 252 | | 8 | | |
| Sm 151 | | 8 | | | Other a | | | | |
| Eu 152 | | 8 | | | Other b/g | | | | |
| Eu 154 | 2.89E-06 | CC 2 | | | Total a | 2.32E-04 | CC 2 | 0 | |
| Eu 155 | 3.98E-07 | CC 2 | | | Total b/g | 2.26E-01 | CC 2 | 0 | |

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