## WASTE STREAM 9G110 Reactor LLW

| | |
|---|---|
| **SITE** | Trawsfynydd |
| **SITE OWNER** | Nuclear Decommissioning Authority |
| **WASTE CUSTODIAN** | Magnox Limited |
| **WASTE TYPE** | LLW |
| Is the waste subject to Scottish Policy: | No |

**WASTE VOLUMES**

| | | Reported |
|---|---|---|
| Stocks: | At 1.4.2022..... | 0 m³ |
| Future arisings - | 1.4.2031 - 31.3.2077..... | 90.0 m³ |
| Total future arisings: | | 90.0 m³ |
| Total waste volume: | | 90.0 m³ |

Comment on volumes: Arisings are assumed to be approximately 2m3 per year for each of the 45 years of Care & Maintenance. Care & Maintenance is assumed to start in 2031 after Care & Maintenance Preparation has been completed.

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 general reactor area during Care and Maintenance.

### PHYSICAL CHARACTERISTICS

| | |
|---|---|
| General description: | Mixed plastic sheeting and protective clothing. There are no large items expected. |
| Physical components (%vol): | Plastic,cloth and steel drums. |
| Sealed sources: | The waste does not contain sealed sources. |
| Bulk density (t/m³): | ~0.4 |
| Comment on density: | The density is likely to lie between 0.3 and 1.0 t/m3. |

### CHEMICAL COMPOSITION

General description and components (%wt): The waste comprises various plastics, cloth and steel drums. Percentage breakdown of components not assessed.

Chemical state: Neutral

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

Metals and alloys (%wt): Bulk and sheet metal are not expected to be present in significant quantities and have not been assessed.

| | (%wt) | Type(s) / Grade(s) with proportions | % of total C14 activity |
|---|---|---|---|
| Stainless steel..... | NE | | |
| Other ferrous metals..... | ~25.0 | | |
| Iron..... | | | |
| Aluminium..... | NE | | |
| Beryllium..... | | | |
| Cobalt..... | | | |

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| | |
|---|---|
| Copper | NE |
| Lead | NE |
| Magnox/Magnesium | NE |
| Nickel | |
| Titanium | |
| Uranium | |
| Zinc | TR |
| Zircaloy/Zirconium | NE |
| Other metals | NE |

Organics (%wt): A wide variety of materials may be present. The presence or absence of halogenated plastics and rubbers remains to be confirmed.

| | (%wt) | Type(s) and comment | % of total C14 activity |
|---|---|---|---|
| Total cellulosics | NE | | |
| Paper, cotton | ~55.0 | | |
| Wood | NE | | |
| Halogenated plastics | ~10.0 | | |
| Total non-halogenated plastics | NE | | |
| Condensation polymers | NE | | |
| Others | NE | | |
| Organic ion exchange materials | 0 | | |
| Total rubber | ~10.0 | | |
| Halogenated rubber | ~10.0 | | |
| 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): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|---|---|---|---|
| Inorganic ion exchange materials | 0 | | |
| Inorganic sludges and flocs | 0 | | |
| Soil | 0 | | |
| Brick/Stone/Rubble | 0 | | |
| Cementitious material | 0 | | |
| Sand | | | |
| Glass/Ceramics | NE | | |
| Graphite | 0 | | |
| Desiccants/Catalysts | | | |

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| | |
|---|---|
| Asbestos | 0 |
| Non/low friable | |
| Moderately friable | |
| Highly friable | |
| Free aqueous liquids | 0 |
| Free non-aqueous liquids | 0 |
| Powder/Ash | 0 |

Inorganic anions (%wt): None expected.

| | (%wt) | Type(s) and comment |
|---|---|---|
| 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: No materials likely to pose a fire or other non-radiological hazard have been identified.

| | (%wt) | Type(s) and comment |
|---|---|---|
| Combustible metals | 0 | |
| Low flash point liquids | 0 | |
| Explosive materials | 0 | |
| Phosphorus | 0 | |
| Hydrides | 0 | |
| Biological etc. materials | 0 | |
| Biodegradable materials | 0 | |
| Putrescible wastes | 0 | |
| Non-putrescible wastes | | |
| Corrosive materials | 0 | |
| Pyrophoric materials | 0 | |
| Generating toxic gases | 0 | |
| Reacting with water | 0 | |
| Higher activity particles | | |
| Soluble solids as bulk chemical compounds | | |

Hazardous substances / non hazardous pollutants: None expected

| | (%wt) | Type(s) and comment |
|---|---|---|
| Acrylamide | | |

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| | |
|---|---|
| Benzene..... | |
| Chlorinated solvents..... | |
| Formaldehyde..... | |
| Organometallics..... | |
| Phenol..... | |
| Styrene..... | |
| Tri-butyl phosphate..... | |
| Other organophosphates..... | |
| Vinyl chloride..... | |
| Arsenic..... | |
| Barium..... | |
| Boron..... | 0 |
| Boron (in Boral)..... | |
| Boron (non-Boral)..... | |
| 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

| | (%wt) | Type(s) and comment |
|---|---|---|
| EDTA..... | | |
| DPTA..... | | |
| NTA..... | | |
| Polycarboxylic acids……. | | |
| Other organic complexants..... | | |
| Total complexing agents..... | 0 | |

Potential for the waste to contain discrete items: No.

## WASTE STREAM 9G110 Reactor LLW

**TREATMENT, PACKAGING AND DISPOSAL**

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

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

Comment on planned treatments: -

**Disposal Routes:**

| Disposal Route | Stream volume % | Disposal density t/m3 |
|---|---|---|
| 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 | 0.40 |

Classification codes for waste expected to be consigned to a landfill facility: -

**Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):**

| Disposal Route | Stream volume % | | |
|---|---|---|---|
| | 2022/23 | 2023/24 | 2024/25 |
| 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 | | | |

**Opportunities for alternative disposal routing:** -

| Baseline Management Route | Opportunity Management Route | Stream volume (%) | Estimated Date that Opportunity will be realised | Opportunity Confidence | Comment |
|---|---|---|---|---|---|
| - | - | - | - | - | - |

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

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| Container | Stream volume % | Waste loading m³ | 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: -

**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: Only approximate estimates have been made of the specific activities.

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: The specific activities have been estimated from the activity of stream 9G105 decayed to 2031.

Other information: Activity estimates are shown in the table.

## WASTE STREAM 9G110 Reactor LLW

| Nuclide | Mean radioactivity, TBq/m³ | | | | Nuclide | Mean radioactivity, TBq/m³ | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Waste at 1.4.2022 | Bands and Code | Future arisings | Bands and Code | | Waste at 1.4.2022 | Bands and Code | Future arisings | Bands and Code |
| H 3 | | | 4.23E-05 | C D 2 | Gd 153 | | | | 8 |
| Be 10 | | | | 8 | Ho 163 | | | | 8 |
| C 14 | | | 7E-06 | C D 2 | Ho 166m | | | | 8 |
| Na 22 | | | | 8 | Tm 170 | | | | 8 |
| Al 26 | | | | 8 | Tm 171 | | | | 8 |
| Cl 36 | | | 4E-06 | C D 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 | | | 9.34E-07 | C C 2 | Pb 210 | | | | 8 |
| Co 60 | | | 1.35E-06 | C C 2 | Bi 208 | | | | 8 |
| Ni 59 | | | | 8 | Bi 210m | | | | 8 |
| Ni 63 | | | 5.88E-06 | C D 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 | | | 2.79E-06 | C C 2 | 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 | | | 1E-06 | C D 2 | Th 234 | | | 1E-09 | C C 2 |
| Mo 93 | | | | 8 | Pa 231 | | | | 8 |
| Tc 97 | | | | 8 | Pa 233 | | | | 8 |
| Tc 99 | | | | 8 | U 232 | | | | 8 |
| Ru 106 | | | | 8 | U 233 | | | | 8 |
| Pd 107 | | | | 8 | U 234 | | | | 8 |
| Ag 108m | | | 9.95E-09 | C D 2 | U 235 | | | | 8 |
| Ag 110m | | | | 8 | U 236 | | | | 8 |
| Cd 109 | | | | 8 | U 238 | | | 1E-09 | C C 2 |
| Cd 113m | | | | 8 | Np 237 | | | | 8 |
| Sn 119m | | | | 8 | Pu 236 | | | | 8 |
| Sn 121m | | | | 8 | Pu 238 | | | 4.88E-07 | C C 2 |
| Sn 123 | | | | 8 | Pu 239 | | | 5E-07 | C C 2 |
| Sn 126 | | | | 8 | Pu 240 | | | 6E-07 | C C 2 |
| Sb 125 | | | | 8 | Pu 241 | | | 8.66E-06 | C C 2 |
| Sb 126 | | | | 8 | Pu 242 | | | | 8 |
| Te 125m | | | | 8 | Am 241 | | | 2.03E-06 | C C 2 |
| Te 127m | | | | 8 | Am 242m | | | | 8 |
| I 129 | | | | 8 | Am 243 | | | | 8 |
| Cs 134 | | | | 8 | Cm 242 | | | | 8 |
| Cs 135 | | | | 8 | Cm 243 | | | 1.86E-09 | C C 2 |
| Cs 137 | | | 2.8E-06 | C C 2 | Cm 244 | | | 4.46E-08 | C C 2 |
| Ba 133 | | | 2.47E-09 | C C 2 | 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 | | | 9.08E-09 | C C 2 | Cf 251 | | | | 8 |
| Sm 147 | | | | 8 | Cf 252 | | | | 8 |
| Sm 151 | | | | 8 | Other a | | | | |
| Eu 152 | | | 8.57E-09 | C C 2 | Other b/g | | | | |
| Eu 154 | | | 7.86E-08 | C C 2 | **Total a** | **0** | | **3.67E-06** | **C C 2** |
| Eu 155 | | | | 8 | **Total b/g** | **0** | | **7.68E-05** | **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