## WASTE STREAM 5G308 Legacy Decommissioning LLW

| | |
|---|---|
| **SITE** | Winfrith |
| **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..... | 180.3 m³ |
| Total future arisings: | | 0 m³ |
| Total waste volume: | | 180.3 m³ |

Comment on volumes: Volume reassessed since 2013 UKRWI and now aligned with stock spreadsheet and LTP data. Historic wastes arising from previous operations and decommissioning of various Winfrith facilities (most notably SGHWR and DRAGON). This waste is subject to an ongoing programme of characterisation with the objective of identifying appropriate disposal routes.

Uncertainty factors on volumes:

| | | | |
|---|---|---|---|
| Stock (upper): | x 1.5 | Arisings (upper) | x |
| Stock (lower): | x 0.5 | Arisings (lower) | x |

**WASTE SOURCE** This waste stream covers historic and legacy wastes from facilities across the Winfrith site.

### PHYSICAL CHARACTERISTICS

General description: The wastes arose from a variety of facilities that are no longer in existence, including but not limited to:Reactor Safety Test Compound (RSTC); Fire test area;Commercial supercompaction operations prior to 1990;laboratory experimentation and trial fabrication;PIE facility and supporting systems such as drains and vents;Historic waste processing operations Current waste processing activities Legacy NDA (UKAEA) assets - known as SAFER or DRAWMOPS liability.

Physical components (%wt): Mainly metal (93%) Concrete (1%), plus plastic (3%), rubber (1%), biodegradables (1%) and others (1%) including spent shot / paint / rust mixture from the WACM process, Beryllium contaminated soft wastes, Mercury and mercury contaminated wastes and Oil and oily wastes (~0.5%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.28

Comment on density: Taken from WCH mass divided by volume.

### CHEMICAL COMPOSITION

General description and components (%wt): Mainly metal (93%) Concrete (1%), plus plastic (3%), rubber (1%), biodegradables (1%) and others (1%) including spent shot / paint / rust mixture from the WACM process, Beryllium contaminated soft wastes, Mercury and mercury contaminated wastes and Oil and oily wastes (~0.5%).

Chemical state: Neutral

Chemical form of radionuclides: -

Metals and alloys (%wt): -

| | (%wt) | Type(s) / Grade(s) with proportions | % of total C14 activity |
|---|---|---|---|
| Stainless steel..... | ~17.9 | Tank pieces, pipework, | |
| Other ferrous metals..... | ~63.5 | Drums (TC-19), plant, pipes, plate metal, vessels | |
| Iron..... | | | |
| Aluminium..... | ~0.80 | Solid (plant/vessel components, building wire, sheathing) | |
| Beryllium..... | ~0.10 | Contamination PPE / Soft Waste | |

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| | | |
|---|---|---|
| Cobalt | | |
| Copper | | |
| Lead | ~4.8 | Shielding blocks |
| Magnox/Magnesium | | |
| Nickel | | |
| Titanium | | |
| Uranium | | |
| Zinc | | |
| Zircaloy/Zirconium | 0 | |
| Other metals | ~5.5 | Not detailed in WCH |

Organics (%wt): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|---|---|---|---|
| Total cellulosics | 0 | | |
| Paper, cotton | | | |
| Wood | | | |
| Halogenated plastics | ~0.08 | PVC - PPE/Soft Waste | |
| Total non-halogenated plastics | ~1.6 | PPE/ Soft Waste | |
| Condensation polymers | ~0.80 | | |
| Others | ~0.80 | | |
| Organic ion exchange materials | 0 | | |
| Total rubber | ~1.0 | | |
| Halogenated rubber | ~0.50 | Neoprene | |
| Non-halogenated rubber | ~0.50 | | |
| Hydrocarbons | ~0.54 | | |
| Oil or grease | ~0.50 | | |
| Fuel | | | |
| Asphalt/Tarmac (cont.coal tar) | | | |
| Asphalt/Tarmac (no coal tar) | 0.04 | Solid (rubble containing tarmac) | |
| Bitumen | | | |
| Others | | | |
| Other organics | P | | |

Other materials (%wt): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|---|---|---|---|
| Inorganic ion exchange materials | 0 | | |
| Inorganic sludges and flocs | 0 | | |
| Soil | | | |
| Brick/Stone/Rubble | | | |
| Cementitious material | ~1.0 | | |
| Sand | | | |
| Glass/Ceramics | 0 | | |
| Graphite | 0 | | |

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| | | |
|---|---|---|
| Desiccants/Catalysts..... | | |
| Asbestos..... | | There is likely to be some quantity of asbestos present. |
| Non/low friable..... | | |
| Moderately friable..... | | |
| Highly friable..... | | |
| Free aqueous liquids..... | 0 | |
| Free non-aqueous liquids..... | | |
| Powder/Ash..... | 0 | |

Inorganic anions (%wt): Anions may be present as components of soil and cement.

| | (%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: Oil and grease content at <0.5% (no liquid oil or grease content other than surface smearing, no visible oil or grease released by leaching). Some waste associated with the sewage plant (ALES) containing traces of very well rotted, dried, active sewage sludge will be present at <2% (expected to meet CFA requirements).

| | (%wt) | Type(s) and comment |
|---|---|---|
| Combustible metals..... | 0 | |
| Low flash point liquids..... | 0 | |
| Explosive materials..... | 0 | |
| Phosphorus..... | 0 | |
| Hydrides..... | 0 | |
| Biological etc. materials..... | | |
| Biodegradable materials..... | ~1.0 | |
| Putrescible wastes..... | ~1.0 | |
| Non-putrescible wastes..... | 0 | |
| Corrosive materials..... | 0 | |
| Pyrophoric materials..... | 0 | |
| Generating toxic gases..... | 0 | |
| Reacting with water..... | 0 | |
| Higher activity particles..... | | |
| Soluble solids as bulk chemical compounds..... | | |

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Hazardous substances / non hazardous pollutants: Certain items contain beryllium metal, asbestos, cadmium and traces of mercury. Trace amounts of Thermite/Sodium contamination.

| | (%wt) | Type(s) and comment |
|---|---|---|
| Acrylamide..... | | |
| 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..... | ~0.10 | Contamination PPE / Soft Waste / Swabs |
| Others..... | | |
| Electronic Electrical Equipment (EEE) | | |
| EEE Type 1..... | P | 30 off Old computers, disc drives, monitors, obsolete HP portable monitoring equipment, etc, from active work areas. |
| EEE Type 2..... | P | 20 off Electrical controls / systems for disused supercompactor. |
| EEE Type 3..... | P | 5 off A limited amount of tooling from characterisation / size reduction of legacy wastes (drills, saws). |
| 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: Not yet determined. In & of itself not a DI; waste stream may include DIs (notably any stainless steel components). Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs.

**TREATMENT, PACKAGING AND DISPOSAL**

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

| Treatment | On-site / Off site | Stream volume % |
|---|---|---|
| Low force compaction | | |
| Supercompaction (HFC) | | |
| Incineration | Off-site | 10.0 |
| Solidification | | |
| Decontamination | | |
| Metal treatment | | |
| Size reduction | | |
| Decay storage | | |
| Recyling / reuse | | |
| Other / various | | |
| None | | ~90.0 |

Comment on planned treatments: 76% of this stream is expected to be disposed of as VLLW to landfill

**Disposal Routes:**

| Disposal Route | Stream volume % | Disposal density t/m3 |
|---|---|---|
| Expected to be consigned to the LLW Repository | 14.0 | 1.3 |
| Expected to be consigned to a Landfill Facility | 76.0 | 1.3 |
| Expected to be consigned to an On-Site Disposal Facility | | |
| Expected to be consigned to an Incineration Facility | 10.0 | 0.40 |
| 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 | | |

Classification codes for waste expected to be consigned to a landfill facility: 17 04 05, 17 04 07, 17 06 01*

**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 | | | |
| 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 | | | |

**Opportunities for alternative disposal routing:** -

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

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**Waste Packaging for Disposal:**

| 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 | ~14.0 | ~10 | 3 |

Other information: -

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

Container voidage: Inaccessible voidage < 10% payload volume.

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste has a current WCH.
Inventory information is consistent with the current WCH.

Waste consigned for disposal to LLWR in year of generation: No. Majority of wastes have been in temporary storage at Winfrith for less than 10 years.

**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: The waste could contain fission products and/or activation products.

Uncertainty: -

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-2WIN-0-WCH-0-4240 V2 and decayed by 5 years to 2022.

Other information: -

## WASTE STREAM 5G308 Legacy Decommissioning LLW

| Nuclide | Mean radioactivity, TBq/m³ Waste at 1.4.2022 | Bands and Code | Future arisings | Bands and Code | Nuclide | Mean radioactivity, TBq/m³ Waste at 1.4.2022 | Bands and Code | Future arisings | Bands and Code |
|---|---|---|---|---|---|---|---|---|---|
| H 3 | 1.22E-05 | C C 2 | | | Gd 153 | | 8 | | |
| Be 10 | | 8 | | | Ho 163 | | 8 | | |
| C 14 | 4.26E-08 | C C 2 | | | Ho 166m | | 8 | | |
| Na 22 | | 8 | | | Tm 170 | | 8 | | |
| Al 26 | | 8 | | | Tm 171 | | 8 | | |
| Cl 36 | | 8 | | | 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 | 2.54E-09 | C C 2 | | | Tl 204 | | 8 | | |
| Mn 54 | | 8 | | | Pb 205 | | 8 | | |
| Fe 55 | 1.34E-08 | C C 2 | | | Pb 210 | | 8 | | |
| Co 60 | 5.99E-07 | C C 2 | | | Bi 208 | | 8 | | |
| Ni 59 | | 8 | | | Bi 210m | | 8 | | |
| Ni 63 | 5.83E-06 | C C 2 | | | Po 210 | | 8 | | |
| Zn 65 | | 8 | | | Ra 223 | 2.3E-08 | C C 2 | | |
| Se 79 | | 8 | | | Ra 225 | | 8 | | |
| Kr 81 | | 8 | | | Ra 226 | | 8 | | |
| Kr 85 | | 8 | | | Ra 228 | 1.82E-08 | C C 2 | | |
| Rb 87 | | 8 | | | Ac 227 | 2.35E-08 | C C 2 | | |
| Sr 90 | 1.74E-05 | C C 2 | | | Th 227 | 2.28E-08 | C C 2 | | |
| Zr 93 | 1.01E-09 | C C 2 | | | Th 228 | 1.67E-08 | C C 2 | | |
| Nb 91 | | 8 | | | Th 229 | | 8 | | |
| Nb 92 | | 8 | | | Th 230 | 4.02E-08 | C C 2 | | |
| Nb 93m | | 8 | | | Th 232 | 4.02E-08 | C C 2 | | |
| Nb 94 | | 8 | | | Th 234 | 2.66E-07 | C C 2 | | |
| Mo 93 | | 8 | | | Pa 231 | 1.59E-07 | C C 2 | | |
| Tc 97 | | 8 | | | Pa 233 | 4.79E-08 | C C 2 | | |
| Tc 99 | | 8 | | | U 232 | | 8 | | |
| Ru 106 | | 8 | | | U 233 | 1.69E-06 | C C 2 | | |
| Pd 107 | | 8 | | | U 234 | 4.14E-07 | C C 2 | | |
| Ag 108m | | 8 | | | U 235 | 9.39E-08 | C C 2 | | |
| Ag 110m | | 8 | | | U 236 | 1.9E-09 | C C 2 | | |
| Cd 109 | | 8 | | | U 238 | 2.66E-07 | C C 2 | | |
| Cd 113m | | 8 | | | Np 237 | 4.79E-08 | C C 2 | | |
| Sn 119m | | 8 | | | Pu 236 | | 8 | | |
| Sn 121m | | 8 | | | Pu 238 | 7.04E-07 | C C 2 | | |
| Sn 123 | | 8 | | | Pu 239 | 2.63E-05 | C C 2 | | |
| Sn 126 | | 8 | | | Pu 240 | 5.37E-06 | C C 2 | | |
| Sb 125 | | 8 | | | Pu 241 | 3.61E-05 | C C 2 | | |
| Sb 126 | | 8 | | | Pu 242 | 1.83E-09 | C C 2 | | |
| Te 125m | | 8 | | | Am 241 | 7.09E-06 | C C 2 | | |
| Te 127m | | 8 | | | Am 242m | | 8 | | |
| I 129 | 3.65E-09 | C C 2 | | | Am 243 | 2.25E-08 | C C 2 | | |
| Cs 134 | | 8 | | | Cm 242 | | 8 | | |
| Cs 135 | | 8 | | | Cm 243 | 2.03E-07 | C C 2 | | |
| Cs 137 | 4.56E-05 | C C 2 | | | Cm 244 | 3.4E-07 | C C 2 | | |
| Ba 133 | | 8 | | | Cm 245 | 2.24E-08 | C C 2 | | |
| 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 | 1.73E-08 | C C 2 | | | **Total a** | **4.29E-05** | **C C 2** | **0** | |
| Eu 155 | | 8 | | | **Total b/g** | **1.18E-04** | **C C 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