## WASTE STREAM 2N16 VLLW from PCM Operations

| | |
|---|---|
| **SITE** | LLWR (near Drigg) |
| **SITE OWNER** | Nuclear Decommissioning Authority |
| **WASTE CUSTODIAN** | LLWR SLC Limited |
| **WASTE TYPE** | VLLW |
| Is the waste subject to Scottish Policy: | No |

**WASTE VOLUMES**

| | | Reported |
|---|---|---|
| Stocks: | At 1.4.2022..... | 38.5 m³ |
| Future arisings - | 1.4.2022 - 31.3.2023..... | 0 m³ |
| Total future arisings: | | 0 m³ |
| Total waste volume: | | 38.5 m³ |

Comment on volumes: No arisings as waste has been generated.

Uncertainty factors on volumes:

| | | | |
|---|---|---|---|
| Stock (upper): | x 1.3 | Arisings (upper) | x |
| Stock (lower): | x 0.7 | Arisings (lower) | x |

**WASTE SOURCE** Scabbling operations, coring, breaking out, sweepings, floor removal.

### PHYSICAL CHARACTERISTICS

| | |
|---|---|
| General description: | Building materials including: bricks, scabbled concrete, bitumen flooring. No physical or chemical processes/changes have occurred since the waste was generated. |
| Physical components (%wt): | Bitumen (6%), concrete and rubble (92%), other organics (plasterboard) (2%). |
| Sealed sources: | The waste does not contain sealed sources. |
| Bulk density (t/m³): | ~0.7 |
| Comment on density: | Bulk density is based on an estimate of the total waste mass divided by the total waste volume. |

### CHEMICAL COMPOSITION

| | |
|---|---|
| General description and components (%wt): | Building materials and materials generated from the decomissioning process.Bitumen (6%), concrete and rubble (92%), other organics (plasterboard)(2%). |
| Chemical state: | Alkali |
| Chemical form of radionuclides: | H-3: Trace quantities could be present as organically bound or free tritium.<br>C-14: Not expected to be present.<br>Cl-36: Not expected to be present.<br>Se-79: Not expected to be present.<br>Tc-99: Not expected to be present.<br>I-129: Not expected to be present.<br>Ra: Could be present as metals, oxides or other forms.<br>Th: Could be present as metals, oxides or other forms.<br>U: Oxides, fluorides.<br>Np: Could be present as metals, oxides or other forms.<br>Pu: Nitrate, sulphide, fluoride or mixed oxides. |
| Metals and alloys (%wt): | - |

| | (%wt) | Type(s) / Grade(s) with proportions | % of total C14 activity |
|---|---|---|---|
| Stainless steel..... | 0 | | |
| Other ferrous metals..... | 0 | | |
| Iron..... | 0 | | |
| Aluminium..... | 0 | | |
| Beryllium..... | 0 | | |
| Cobalt..... | 0 | | |
| Copper..... | 0 | | |

**WASTE STREAM 2N16 VLLW from PCM Operations**

| | |
|---|---|
| Lead | 0 |
| Magnox/Magnesium | 0 |
| Nickel | 0 |
| Titanium | 0 |
| Uranium | 0 |
| Zinc | 0 |
| Zircaloy/Zirconium | 0 |
| Other metals | 0 |

Organics (%wt): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|---|---|---|---|
| Total cellulosics | 0 | | |
| Paper, cotton | 0 | | |
| Wood | 0 | | |
| Halogenated plastics | 0 | | |
| Total non-halogenated plastics | 0 | | |
| Condensation polymers | 0 | | |
| Others | 0 | | |
| Organic ion exchange materials | 0 | | |
| Total rubber | 0 | | |
| Halogenated rubber | 0 | | |
| Non-halogenated rubber | 0 | | |
| Hydrocarbons | 8.0 | | |
| Oil or grease | 0 | | |
| Fuel | 0 | | |
| Asphalt/Tarmac (cont.coal tar) | 0 | | |
| Asphalt/Tarmac (no coal tar) | 0 | | |
| Bitumen | ~6.0 | | |
| Others | ~2.0 | plasterboard (potentially containing gypsum) | |
| Other organics | 0 | | |

Other materials (%wt): others include plasterboard (potentially containing gypsum)

| | (%wt) | Type(s) and comment | % of total C14 activity |
|---|---|---|---|
| Inorganic ion exchange materials | 0 | | |
| Inorganic sludges and flocs | 0 | | |
| Soil | 0 | | |
| Brick/Stone/Rubble | ~92.0 | Concrete and scabbling waste. | |
| Cementitious material | 0 | | |
| Sand | 0 | | |
| Glass/Ceramics | 0 | | |
| Graphite | | | |
| Desiccants/Catalysts | 0 | | |
| Asbestos | 0 | | |

## WASTE STREAM 2N16 VLLW from PCM Operations

| | | |
|---|---|---|
| Non/low friable | 0 | |
| Moderately friable | 0 | |
| Highly friable | 0 | |
| Free aqueous liquids | 0 | |
| Free non-aqueous liquids | 0 | |
| Powder/Ash | 0 | Dust waste may be diverted from the PCM route. |

Inorganic anions (%wt): Not expected to be added - only physical processes are being applied for decontamination.

| | (%wt) | Type(s) and comment |
|---|---|---|
| Fluoride | NE | |
| Chloride | NE | |
| Iodide | NE | |
| Cyanide | NE | |
| Carbonate | NE | |
| Nitrate | NE | |
| Nitrite | NE | |
| Phosphate | NE | |
| Sulphate | NE | |
| Sulphide | NE | |

Materials of interest for waste acceptance criteria: The scabbled concrete will be in a powder form.

| | (%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 | 0 | |
| Corrosive materials | 0 | |
| Pyrophoric materials | 0 | |
| Generating toxic gases | 0 | |
| Reacting with water | 0 | |
| Higher activity particles | 0 | |
| Soluble solids as bulk chemical compounds | 0 | |

Hazardous substances / non hazardous pollutants: Bitumen flooring (degraded with a low Benz[a]pyrene content), some of the concrete could be contaminated with hydrocarbons from the bitumen flooring and oils.

| | (%wt) | Type(s) and comment |
|---|---|---|
| Acrylamide | 0 | |
| Benzene | NE | Not estimated. |

**WASTE STREAM 2N16 VLLW from PCM Operations**

| | | |
|---|---|---|
| Chlorinated solvents..... | | |
| Formaldehyde..... | 0 | |
| Organometallics..... | 0 | |
| Phenol..... | NE | Not estimated. |
| Styrene..... | 0 | |
| Tri-butyl phosphate..... | 0 | |
| Other organophosphates..... | 0 | |
| Vinyl chloride..... | NE | Not estimated. |
| Arsenic..... | NE | Not estimated. |
| Barium..... | 0 | |
| Boron..... | NE | Not estimated. |
| Boron (in Boral)..... | 0 | |
| Boron (non-Boral)..... | 0 | |
| Cadmium..... | NE | |
| Caesium..... | 0 | |
| Selenium..... | NE | Not estimated. |
| Chromium..... | 0 | |
| Molybdenum..... | 0 | |
| Thallium..... | 0 | |
| Tin..... | NE | Not estimated. |
| Vanadium..... | NE | Not estimated. |
| Mercury compounds..... | 0 | |
| Others..... | 0 | |
| Electronic Electrical Equipment (EEE) | | |
| EEE Type 1..... | 0 | |
| EEE Type 2..... | 0 | |
| EEE Type 3..... | 0 | |
| EEE Type 4..... | 0 | |
| EEE Type 5..... | 0 | |

Complexing agents (%wt): No

| | (%wt) | Type(s) and comment |
|---|---|---|
| EDTA..... | 0 | |
| DPTA..... | 0 | |
| NTA..... | 0 | |
| Polycarboxylic acids……. | 0 | Not estimated. |
| Other organic complexants..... | 0 | Not estimated. |
| Total complexing agents..... | 0 | |

Potential for the waste to contain discrete items: No.

## WASTE STREAM 2N16 VLLW from PCM Operations

**TREATMENT, PACKAGING AND DISPOSAL**

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

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

Comment on planned treatments: Impervious solids are being decontaminated, higher activity areas are being removed from porus solids (e.g. by concrete scabbling).

**Disposal Routes:**

| Disposal Route | Stream volume % | Disposal density t/m3 |
|---|---|---|
| Expected to be consigned to the LLW Repository | | |
| Expected to be consigned to a Landfill Facility | ~100.0 | ~0.70 |
| 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 | | |

Classification codes for waste expected to be consigned to a landfill facility: Scabbling operations, coring, breaking out, sweepings, floor removal.

**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 |
|---|---|---|---|---|---|
| - | - | - | - | - | - |

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

## WASTE STREAM 2N16 VLLW from PCM Operations

| Container | Stream volume % | Waste loading m³ | Number of packages |
|---|---|---|---|
| 1/3 Height IP-1 ISO | | | |
| 2/3 Height IP-2 ISO | | | |
| 1/2 Height WAMAC IP-2 ISO | | | |
| 1/2 Height IP-2 Disposal/Re-usable ISO | | | |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other (IP2 rated drums) | | | |

Other information: The figures are estimates based on raw waste volumes and assumes waste is accumulated and disposed of the year after generation. Waste will more likely be disposed of along a timeline driven by accumulating sufficient waste to fill whole packages.

**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: Waste has become contaminated through contact with PCM waste stored / processed in the buildings.

Uncertainty: Specfic activities have been based on sample results for waste items or similar waste items or inferred from monitoring data where available, but the majority of the waste volume is still to be characterised. Specific activities by mass have been converted to specific activties by volume, so uncertaities in the volume estimates will also be carried over.

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: A number of characterisation methods have been used including; sampling, hand held monitoring and LRGS (for soft waste). The majority of measurement data used has been collected in the past two years.

Other information: Waste is present with a range of specific activities within the VLLW category.

## WASTE STREAM 2N16 VLLW from PCM Operations

| 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 | ~6.18E-12 | C C 2 | | | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | | | | | Ho 166m | | | | |
| Na 22 | | | | | Tm 170 | | | | |
| Al 26 | | | | | Tm 171 | | | | |
| Cl 36 | | | | | Lu 174 | | | | |
| Ar 39 | | | | | Lu 176 | | | | |
| Ar 42 | | | | | Hf 178n | | | | |
| K 40 | ~7.46E-11 | C C 2 | | | Hf 182 | | | | |
| Ca 41 | | | | | Pt 193 | | | | |
| Mn 53 | | | | | Tl 204 | | | | |
| Mn 54 | | | | | Pb 205 | | | | |
| Fe 55 | ~1.23E-13 | C C 2 | | | Pb 210 | ~3.92E-11 | C C 2 | | |
| Co 60 | ~3.48E-14 | C C 2 | | | Bi 208 | | | | |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | | | | | Po 210 | ~3.67E-11 | C C 2 | | |
| Zn 65 | | | | | Ra 223 | | | | |
| Se 79 | | | | | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | ~4.25E-11 | C C 2 | | |
| Kr 85 | | | | | Ra 228 | ~5.79E-11 | C C 2 | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | | | | | Th 227 | | | | |
| Zr 93 | | | | | Th 228 | ~1.17E-10 | C C 2 | | |
| Nb 91 | | | | | Th 229 | ~8.27E-14 | C C 2 | | |
| Nb 92 | | | | | Th 230 | ~3.82E-11 | C C 2 | | |
| Nb 93m | | | | | Th 232 | ~1.41E-10 | C C 2 | | |
| Nb 94 | | | | | Th 234 | ~3.76E-12 | C C 2 | | |
| Mo 93 | | | | | Pa 231 | | | | |
| Tc 97 | | | | | Pa 233 | | | | |
| Tc 99 | ~2.34E-12 | C C 2 | | | U 232 | ~7.36E-13 | C C 2 | | |
| Ru 106 | | | | | U 233 | | | | |
| Pd 107 | | | | | U 234 | ~6.46E-09 | B B 2 | | |
| Ag 108m | | | | | U 235 | ~2.72E-10 | B B 2 | | |
| Ag 110m | | | | | U 236 | ~5.29E-12 | B B 2 | | |
| Cd 109 | | | | | U 238 | ~7.35E-10 | C C 2 | | |
| Cd 113m | | | | | Np 237 | ~2.21E-12 | C C 2 | | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | ~4.46E-09 | B B 2 | | |
| Sn 123 | | | | | Pu 239 | ~2.05E-07 | B B 2 | | |
| Sn 126 | | | | | Pu 240 | ~1.54E-08 | B B 2 | | |
| Sb 125 | | | | | Pu 241 | ~1.43E-07 | B B 2 | | |
| Sb 126 | | | | | Pu 242 | ~2.85E-10 | B B 2 | | |
| Te 125m | | | | | Am 241 | ~6.08E-08 | B B 2 | | |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | | | Am 243 | | | | |
| Cs 134 | | | | | Cm 242 | ~9.33E-13 | C C 2 | | |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | ~1.31E-09 | C C 2 | | | Cm 244 | ~2.02E-13 | C C 2 | | |
| Ba 133 | | | | | Cm 245 | | | | |
| La 137 | | | | | Cm 246 | | | | |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | | | | | Cf 249 | | | | |
| Pm 145 | | | | | Cf 250 | | | | |
| Pm 147 | | | | | Cf 251 | | | | |
| Sm 147 | | | | | Cf 252 | | | | |
| Sm 151 | | | | | Other a | | | | |
| Eu 152 | | | | | Other b/g | | | | |
| Eu 154 | | | | | **Total a** | **~2.93E-07** | **C C 2** | **0** | |
| Eu 155 | | | | | **Total b/g** | **~1.44E-07** | **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