| WASTE STREAM | 2P03 | BTC Level 3 Laboratories and Other General Active Areas |
|---|---|---|

**SITE** Sellafield NNL

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** National Nuclear Laboratory

**WASTE TYPE** LLW

**WASTE VOLUMES**

| | | Reported |
|---|---|---|
| Stocks: | At 1.4.2019..... | 0 m³ |
| Future arisings - | 1.4.2019 - 31.3.2037..... | 752.8 m³ |
| Total future arisings: | | 752.8 m³ |
| Total waste volume: | | 752.8 m³ |

Comment on volumes: This waste stream has been operational since October 2004.

Uncertainty factors on volumes:

| | | | |
|---|---|---|---|
| Stock (upper): | x | Arisings (upper) | x 1.25 |
| Stock (lower): | x | Arisings (lower) | x 0.75 |

**WASTE SOURCE** General laboratory wastes plus general wastes arising from normal building operations.

**PHYSICAL CHARACTERISTICS**

General description: General mixed waste. Large items arise infrequently.

Physical components (%wt): Typically contains paper, tissues, paper towels, cardboard, wood, tacky mats, scrap wrapping materials, polythene bottles, polystyrene packing, gloves, cable, tweezers, metal sheet, pipes, rubble and glassware.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.18

Comment on density: The density of waste is based on the density of waste from the main laboratories (2P01) as this facility is considered to be analogous to the B170 Level 3 Laboratories and other general active areas. Limited disposals to date support this figure. Once waste has been generated in reasonable quantities this figure may be adjusted to provide a better density over its operational period.

**CHEMICAL COMPOSITION**

General description and components (%wt): Metal (2%), Biodegradable - Non-Putrescibles (16%), Halogenated Plastic (21%), Non-Halogenated Plastic (30%), Rubber (14%), Wood (2%), Others (15%). Others consist of glassware contained within rigid containers, Eli-dry absorbant granules loaded with Insta-Gel plus and or Insta-Fluor plus liquid scintilation cocktails and ion-exchange resins, decontamination gel (fumed silica and nitric acid) and oils.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Trace residues left in sample containers
C-14: Trace residues left in sample containers
Cl-36: Trace residues left in sample containers
Se-79: Not anticipated to be present.
Tc-99: Oxides or nitrate solids. Waste drum containing glass boats, soft waste (rubber, paper, wipes) and furnace.
I-129: Trace residues left in sample containers.
Ra: Not anticipated to be present.
Th: Not anticipated to be present.
U: Natural Uranium - U235, U236 and U238, Uranium metal, U oxides (UO2, UO3 and U3O8) powder or U nitrate solids.
Np: Np237 as oxide or nitrate solids.
Pu: Plutonium nitrate solids, plutonium oxides.

Metals and alloys (%wt): Likely to be metals of various thicknesses.

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| | | |
|---|---|---|
| | Stainless steel | <0.20 |
| | Other ferrous metals | <0.20 |
| | Iron | <1.0 |
| | Aluminium | <0.10 |
| | Beryllium | |
| | Cobalt | |
| | Copper | <0.10 |
| | Lead | <0.10 |
| | Magnox/Magnesium | <0.10 |
| | Nickel | |
| | Titanium | <0.10 |
| | Uranium | |
| | Zinc | <0.10 |
| | Zircaloy/Zirconium | |
| | Other metals | |
| Organics (%wt): | - | |
| | Total cellulosics | 17.0 |
| | Paper, cotton | 15.0 |
| | Wood | 2.0 |
| | Halogenated plastics | 21.0 |
| | Total non-halogenated plastics | 30.0 |
| | Condensation polymers | |
| | Others | |
| | Organic ion exchange materials | <1.0 |
| | Total rubber | 14.0 |
| | Halogenated rubber | |
| | Non-halogenated rubber | |
| | Hydrocarbons | |
| | Oil or grease | <1.0 |
| | Fuel | |
| | Asphalt/Tarmac (cont.coal tar) | |
| | Asphalt/Tarmac (no coal tar) | |
| | Bitumen | |
| | Others | |
| | Other organics | Relatively small quantities of liquid scintillation cocktails are also present. |
| Other materials (%wt): | Mixture of glass and Eli-Dry absorbant granules (a clay based material similar to cat litter). The granules have unspecified quantities of liquid scintillation cocktails and ion exchange resins loaded onto them. | |

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| | | | |
|---|---|---|---|
| | Inorganic ion exchange materials. | <1.0 | |
| | Inorganic sludges and flocs..... | <1.0 | Lliquid scintillation cocktails. |
| | Soil..... | | |
| | Brick/Stone/Rubble..... | 1.0 | |
| | Cementitious material..... | 1.0 | Includes grout for resins, decon gels. |
| | Sand..... | | |
| | Glass/Ceramics..... | 10.0 | Glassware, uranium encapsulated in glass. |
| | Graphite..... | | |
| | Desiccants/Catalysts..... | | |
| | Asbestos..... | | |
| | Non/low friable..... | | |
| | Moderately friable..... | | |
| | Highly friable..... | | |
| | Free aqueous liquids..... | | |
| | Free non-aqueous liquids..... | | |
| | Powder/Ash..... | <1.0 | |
| Inorganic anions (%wt): | Trace amounts of various anions may be present. | | |
| | Fluoride..... | | |
| | Chloride..... | | |
| | Iodide..... | | |
| | Cyanide..... | | |
| | Carbonate..... | | |
| | Nitrate..... | | |
| | Nitrite..... | | |
| | Phosphate..... | | |
| | Sulphate..... | | |
| | Sulphide..... | | |
| 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..... | 18.0 | |
| | Putrescible wastes..... | 1.0 | Roof waste |
| | Non-putrescible wastes..... | 17.0 | Paper, cotton and wood. |
| | Corrosive materials..... | | |
| | Pyrophoric materials..... | 0 | |
| | Generating toxic gases..... | 0 | |
| | Reacting with water..... | 0 | |

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| | | | |
|---|---|---|---|
| | Active particles..... | 0 | |
| | Soluble solids as bulk chemical compounds..... | 0 | |
| Hazardous substances / non hazardous pollutants: | May be small amounts, assume <0.1% wt. | | |
| | Acrylamide..... | | |
| | Benzene..... | 0 | |
| | Chlorinated solvents..... | | |
| | Formaldehyde..... | | |
| | Organometallics..... | | |
| | Phenol..... | 0 | |
| | Styrene..... | | |
| | Tri-butyl phosphate..... | 0 | |
| | Other organophosphates..... | | |
| | Vinyl chloride..... | P | PVC bags. |
| | Arsenic..... | 0 | |
| | Barium..... | | |
| | Boron..... | 0 | |
| | Cadmium..... | 0 | |
| | Caesium..... | | |
| | Selenium..... | 0 | |
| | Chromium..... | P | Alloy in stainless steel. |
| | Molybdenum..... | P | Alloy in stainless steel. |
| | Thallium..... | | |
| | Tin..... | 0 | |
| | Vanadium..... | P | Alloy in stainless steel. |
| | Mercury compounds..... | | |
| | Others..... | 0 | |
| | Electronic Electrical Equipment (EEE) | | |
| | EEE Type 1..... | 100.0 | Computers, telephones, circuit boards etc. |
| | EEE Type 2..... | 100.0 | Pumps, motors, transformers etc. |
| | EEE Type 3..... | 100.0 | Hand tools. |
| | EEE Type 4..... | 25.0 | Fluorescent light tubes. |
| | EEE Type 5..... | 25.0 | Lithium ion batteries. |
| Complexing agents (%wt): | Yes | | |
| | EDTA..... | P | 0.00209 kg. |
| | DPTA..... | | |
| | NTA..... | | |
| | Polycarboxylic acids…… | | |
| | Other organic complexants..... | | |
| | Total complexing agents..... | <0.01 | |

## WASTE STREAM 2P03 BTC Level 3 Laboratories and Other General Active Areas

**TREATMENT, PACKAGING AND DISPOSAL**

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

| Treatment | On-site / Off site | Stream volume % |
|---|---|---|
| Low force compaction | | |
| Supercompaction (HFC) | On-site | 96.0 |
| Incineration | | |
| Solidification | | |
| Decontamination | | |
| Metal treatment | On-site | 1.0 |
| Size reduction | | |
| Decay storage | | |
| Recyling / reuse | | |
| Other / various | | |
| None | Off-site | 3.0 |

Comment on planned treatments: -

**Disposal Routes:**

| Disposal Route | Stream volume % |
|---|---|
| Expected to be consigned to the LLW Repository | 99.0 |
| 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 | |
| Expected to be consigned to a Metal Treatment Facility | 1.0 |
| 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 | 96.0 | 59.28 | 13 |
| 1/2 Height IP-2 Disposal/Re-usable ISO | 3.0 | 10 | 3 |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other (Metal treatment) | | | |

Other information: Small heavy duty items from research experiments and supporting plant operations. General laboratory and plant items. Soft wastes from research experiments or supporting plant operations.

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

Container voidage: NNL do not load containers. NNL waste is mixed with Sellafield Ltd waste on

| | |
|---|---|
| | Sellafield site. Voidage and packaging efficiency is determined by Sellafield Ltd. |
| Waste Characterisation Form (WCH): | The waste meets the LLWR's Waste Acceptance Criteria (WAC).<br>The waste has a current WCH.<br>Differences exist between Inventory information and current WCH.<br>The WCH is approved but requires revision to include decontamination gels, oils, and technetium-99 waste. |
| Waste consigned for disposal to LLWR in year of generation: | Yes. |
| Potential for the waste to contain discrete items: | Yes. Large lab equipment such as furnace, microscopes etc. |

**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: | Process waste (such as gloves/paper etc.) contaminated with fission products and other radionuclides will be generated from experiments. |
| Uncertainty: | This is a best estimate at present based on the WSCD and operations to date. |
| 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 fingerprint is based on previous (similar) work when carried out in similar facilities. |
| Other information: | Other beta / gamma on the radionuclide spreadsheet includes Ca45, Zr95 and Nb95. |

## WASTE STREAM 2P03 BTC Level 3 Laboratories and Other General Active Areas

| Nuclide | Mean radioactivity, TBq/m³ Waste at 1.4.2019 | Bands and Code | Future arisings | Bands and Code | Nuclide | Mean radioactivity, TBq/m³ Waste at 1.4.2019 | Bands and Code | Future arisings | Bands and Code |
|---|---|---|---|---|---|---|---|---|---|
| H 3 | | | 7.27E-07 | C C 2 | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | | | 6.01E-08 | C C 2 | Ho 166m | | | | |
| Na 22 | | | | | Tm 170 | | | | |
| Al 26 | | | | | Tm 171 | | | | |
| Cl 36 | | | 3.24E-11 | C C 2 | Lu 174 | | | | |
| Ar 39 | | | | | Lu 176 | | | | |
| Ar 42 | | | | | Hf 178n | | | | |
| K 40 | | | | | Hf 182 | | | | |
| Ca 41 | | | | | Pt 193 | | | | |
| Mn 53 | | | | | Tl 204 | | | | |
| Mn 54 | | | | | Pb 205 | | | | |
| Fe 55 | | | 1.29E-07 | C C 2 | Pb 210 | | | | |
| Co 60 | | | 1.26E-07 | C C 2 | Bi 208 | | | | |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | | | 3.41E-08 | C C 2 | Po 210 | | | | |
| Zn 65 | | | 9.39E-09 | C C 2 | Ra 223 | | | | |
| Se 79 | | | | | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | | | | |
| Kr 85 | | | | | Ra 228 | | | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | | | 1.17E-06 | C C 2 | Th 227 | | | | |
| Zr 93 | | | | | Th 228 | | | | |
| Nb 91 | | | | | Th 229 | | | | |
| Nb 92 | | | | | Th 230 | | | | |
| Nb 93m | | | | | Th 232 | | | | |
| Nb 94 | | | | | Th 234 | | | | |
| Mo 93 | | | | | Pa 231 | | | | |
| Tc 97 | | | | | Pa 233 | | | | |
| Tc 99 | | | 1.74E-11 | C C 2 | U 232 | | | | |
| Ru 106 | | | 2.04E-08 | C C 2 | U 233 | | | | |
| Pd 107 | | | | | U 234 | | | 3.80E-11 | C C 2 |
| Ag 108m | | | | | U 235 | | | 1.77E-12 | C C 2 |
| Ag 110m | | | | | U 236 | | | 1.77E-12 | C C 2 |
| Cd 109 | | | | | U 238 | | | 6.54E-11 | C C 2 |
| Cd 113m | | | | | Np 237 | | | 1.15E-10 | C C 2 |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | | | 9.23E-10 | C C 2 |
| Sn 123 | | | | | Pu 239 | | | 1.64E-09 | C C 2 |
| Sn 126 | | | | | Pu 240 | | | 1.78E-09 | C C 2 |
| Sb 125 | | | 9.54E-09 | C C 2 | Pu 241 | | | 9.60E-08 | C C 2 |
| Sb 126 | | | | | Pu 242 | | | | |
| Te 125m | | | | | Am 241 | | | 1.60E-07 | C C 2 |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | 5.31E-11 | C C 2 | Am 243 | | | | |
| Cs 134 | | | 5.26E-09 | C C 2 | Cm 242 | | | 9.55E-11 | C C 2 |
| Cs 135 | | | | | Cm 243 | | | 2.62E-11 | C C 2 |
| Cs 137 | | | 2.22E-07 | C C 2 | Cm 244 | | | 2.62E-11 | C C 2 |
| Ba 133 | | | 1.35E-09 | C C 2 | Cm 245 | | | | |
| La 137 | | | | | Cm 246 | | | | |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | | | 1.51E-09 | C C 2 | Cf 249 | | | | |
| Pm 145 | | | | | Cf 250 | | | | |
| Pm 147 | | | 1.85E-09 | C C 2 | Cf 251 | | | | |
| Sm 147 | | | | | Cf 252 | | | | |
| Sm 151 | | | | | Other a | | | | |
| Eu 152 | | | | | Other b/g | | | 1.36E-07 | C C 2 |
| Eu 154 | | | 2.11E-08 | C C 2 | **Total a** | **0** | | **1.64E-07** | **C C 2** |
| Eu 155 | | | 1.49E-08 | C C 2 | **Total b/g** | **0** | | **2.78E-06** | **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