

WASTE STREAM**2Y57****Excavated Soil and Putrescible Waste - High Volume
Very Low Level Waste (HVLLW)**

SITE Sellafield
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Sellafield Limited
WASTE TYPE VLLW

WASTE VOLUMES

| | | Reported |
|------------------------|---------------------------|------------------------|
| Stocks: | At 1.4.2019..... | 0 m ³ |
| Future arisings - | 1.4.2019 - 31.3.2020..... | 5052.0 m ³ |
| | 1.4.2020 - 31.3.2021..... | 5052.0 m ³ |
| | 1.4.2021 - 31.3.2022..... | 5052.0 m ³ |
| | 1.4.2022 - 31.3.2023..... | 5052.0 m ³ |
| | 1.4.2023 - 31.3.2024..... | 5052.0 m ³ |
| | 1.4.2024 - 31.3.2025..... | 5052.0 m ³ |
| | 1.4.2025 - 31.3.2026..... | 5052.0 m ³ |
| | 1.4.2026 - 31.3.2027..... | 5052.0 m ³ |
| | 1.4.2027 - 31.3.2028..... | 5052.0 m ³ |
| | 1.4.2028 - 31.3.2029..... | 5052.0 m ³ |
| | 1.4.2029 - 31.3.2030..... | 3802.0 m ³ |
| Total future arisings: | | 54322.0 m ³ |
| Total waste volume: | | 54322.0 m ³ |

Comment on volumes: Arisings compiled from predominantly excavated spoil from construction and demolition concrete / rubble, with smaller amounts of putrescible wastes including roof waste [vegetation], timber, sewage solids, road sweepings and bird/animal carcasses. The future arisings have been calculated using historical volumes from 2006 to 2018, with the arisings rate calculated using the mean plus the standard deviation until the current maximum capacity of CLESA has been reached (120,000 m³). Volumes are as delivered raw volumes (unpacked). Volumes are expected to be within a factor of +/- 2 of estimates provided.

Uncertainty factors on volumes:
 Stock (upper): x Arisings (upper) x 2.0
 Stock (lower): x Arisings (lower) x 0.5

WASTE SOURCE This waste stream is predominantly excavated spoil from construction and demolition concrete / rubble, with smaller amounts of putrescible wastes including roof waste [vegetation], timber, sewage solids, road sweepings and bird/animal carcasses.

PHYSICAL CHARACTERISTICS

General description: All waste will be "tipped" or emplaced in the disposal facility (as per facility Conditions For Acceptance (CFA)). No disposal containers are used. The only physical/chemical processes applied to the waste are crushing (concrete/demolition rubble) and dewatering in the case of sewage/road sweepings.

Physical components (%wt): Miscellaneous construction and demolition materials (98.3%), Organic Material (1.3%), Insulation Materials (MMMMF) (0.1%), Mixed Municipal Wastes (0.1%) and Wood (0.2%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~2

Comment on density: The bulk density ranges from 0.05 to 2.4 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Miscellaneous construction and demolition materials (98.3%), Organic Material (1.3%), Insulation Materials (MMMMF) (0.1%), Mixed Municipal Wastes (0.1%) and Wood (0.2%).

Chemical state: Alkali

Chemical form of radionuclides: -

Metals and alloys (%wt): Mild steel present in the form of reinforcing bar within concrete, where not practicable to remove.

WASTE STREAM

2Y57

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| | | | |
|------------------------|--|-------|---|
| | Stainless steel..... | TR | |
| | Other ferrous metals..... | TR | Mild steel present in the form of reinforcing bar within concrete, where not practicable to remove. |
| | Iron..... | | |
| | Aluminium..... | 0 | |
| | Beryllium..... | 0 | |
| | Cobalt..... | 0 | |
| | Copper..... | 0 | |
| | Lead..... | 0 | |
| | Magnox/Magnesium..... | 0 | |
| | Nickel..... | 0 | |
| | Titanium..... | 0 | |
| | Uranium..... | 0 | |
| | Zinc..... | TR | |
| | Zircaloy/Zirconium..... | 0 | |
| | Other metals..... | 0 | |
| Organics (%wt): | Halogenated/non-halogenated plastics present - to cover "packaging" of some wastes e.g. bird/animal carcasses. | | |
| | Total cellulose..... | ~0.20 | |
| | Paper, cotton..... | TR | |
| | Wood..... | ~0.20 | Small quantities of wood / timber. |
| | Halogenated plastics | TR | |
| | Total non-halogenated plastics..... | TR | |
| | Condensation polymers..... | TR | |
| | Others..... | TR | |
| | Organic ion exchange materials.... | 0 | |
| | Total rubber..... | TR | |
| | Halogenated rubber | TR | |
| | Non-halogenated rubber..... | TR | |
| | Hydrocarbons..... | 1.0 | |
| | Oil or grease | | |
| | Fuel..... | | |
| | Asphalt/Tarmac (cont.coal tar)... | | |
| | Asphalt/Tarmac (no coal tar).... | 1.0 | |
| | Bitumen..... | | |
| | Others..... | | |
| | Other organics..... | ~4.1 | |
| Other materials (%wt): | 82.84 wt% in soil is actually soil and stone combined. | | |
| | Inorganic ion exchange materials. | 0 | |
| | Inorganic sludges and flocs..... | 0 | |
| | Soil..... | ~82.8 | |
| | Brick/Stone/Rubble..... | ~2.2 | |
| | Cementitious material..... | 9.7 | |

WASTE STREAM

2Y57

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| | | | |
|--|---|----|--|
| | Sand..... | TR | |
| | Glass/Ceramics..... | ~ | |
| | Graphite..... | TR | |
| | Desiccants/Catalysts..... | | |
| | Asbestos..... | TR | |
| | Non/low friable..... | | |
| | Moderately friable..... | | |
| | Highly friable..... | | |
| | Free aqueous liquids..... | P | |
| | Free non-aqueous liquids..... | TR | |
| | Powder/Ash..... | TR | |
| Inorganic anions (%wt): | Derived from hydro-geological risk assesment. | | |
| | Fluoride..... | 0 | |
| | Chloride..... | TR | |
| | Iodide..... | 0 | |
| | Cyanide..... | | |
| | Carbonate..... | 0 | |
| | Nitrate..... | TR | |
| | Nitrite..... | 0 | |
| | Phosphate..... | 0 | |
| | Sulphate..... | P | |
| | Sulphide..... | 0 | |
| Materials of interest for waste acceptance criteria: | Putrescible waste (~1 w%). The waste is deemed to be inert or non-hazardous under landfill legislation. The concrete arisings can be alkaline in nature, and give rise to alkaline leachate from the landfill (CLESA) [pH 9 - 12]. Acid dosing of leachate no longer required. | | |
| | Combustible metals..... | 0 | |
| | Low flash point liquids..... | 0 | |
| | Explosive materials..... | 0 | |
| | Phosphorus..... | 0 | |
| | Hydrides..... | 0 | |
| | Biological etc. materials..... | 0 | |
| | Biodegradable materials..... | P | ~~1% |
| | Putrescible wastes..... | P | ~~1% |
| | Non-putrescible wastes..... | | |
| | Corrosive materials..... | 0 | |
| | Pyrophoric materials..... | 0 | |
| | Generating toxic gases..... | P | ~~1% putrescible may give rise to methane and CO2. |
| | Reacting with water..... | 0 | |
| | Active particles..... | 0 | Active particles unlikely to be present. |
| | Soluble solids as bulk chemical compounds..... | 0 | |

WASTE STREAM**2Y57****Excavated Soil and Putrescible Waste - High Volume
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non hazardous pollutants:

| | | |
|---------------------------------------|----|--|
| - | | |
| Acrylamide..... | | |
| Benzene..... | NE | Possible as a trace contaminant. |
| Chlorinated solvents..... | | |
| Formaldehyde..... | | |
| Organometallics..... | | |
| Phenol..... | NE | Possible as a trace contaminant. |
| Styrene..... | | |
| Tri-butyl phosphate..... | NE | Possible as a trace contaminant. |
| Other organophosphates..... | | |
| Vinyl chloride..... | P | Plastic packaging materials can contain vinyl chloride. |
| Arsenic..... | P | Can be present in contaminated soils, but below the level that would make the waste hazardous. |
| Barium..... | | |
| Boron..... | P | Can be present in contaminated soils, but below the level that would make the waste hazardous. |
| Cadmium..... | P | Can be present in contaminated soils, but below the level that would make the waste hazardous. |
| Caesium..... | | |
| Selenium..... | P | Can be present in contaminated soils, but below the level that would make the waste hazardous. |
| Chromium..... | P | Can be present in contaminated soils, but below the level that would make the waste Hazardous. |
| Molybdenum..... | P | Can be present in contaminated soils, but below the level that would make the waste hazardous. |
| Thallium..... | | |
| Tin..... | P | Can be present in contaminated soils, but below the level that would make the waste hazardous. |
| Vanadium..... | P | Can be present in contaminated soils, but below the level that would make the waste hazardous. |
| Mercury compounds..... | | |
| Others..... | P | |
| Electronic Electrical Equipment (EEE) | | |
| EEE Type 1..... | | |
| EEE Type 2..... | | |
| EEE Type 3..... | | |
| EEE Type 4..... | | |
| EEE Type 5..... | | |

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Complexing agents (%wt): No
 EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

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 Recycling / reuse Other / various None | | 100.0 |

Comment on planned treatments:

None planned currently.

Disposal Routes:

| Disposal Route | Stream volume % |
|---|-----------------|
| 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 | 100.0 |

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:

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| 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 | | | |
| 1/2 Height IP-2 Disposal/Re-usable ISO | | | |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other | | | |

Other information: Waste is largely uncompactable and is disposed of as HVLLW uncontainerised.

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: -

Potential for the waste to contain discrete items: -

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: Dependant on plant of origin. May include activation products, fission products, and/or fuel contamination.

Uncertainty: The average specific activities are calculated from characterisation of sentenced arisings, the values differ for each project/location, and can be highly variable.

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 activity of future arisings has been calculated from arisings to date, incorporated with detailed radionuclide fingerprints for the plants of origin and including any anticipated future waste which significantly differs from historic and current arisings .

Other information: Figures based on declared waste stream fingerprints for donor plants for the specific arisings.

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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 | | | 1.66E-06 | CC 2 | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | | | 7.49E-08 | CC 2 | Ho 166m | | | | |
| Na 22 | | | | | Tm 170 | | | | |
| Al 26 | | | | | Tm 171 | | | | |
| Cl 36 | | | 6.95E-08 | CC 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 | | | 9.92E-10 | CC 2 | Pb 205 | | | | |
| Fe 55 | | | 4.31E-07 | CC 2 | Pb 210 | | | | |
| Co 60 | | | 6.46E-08 | CC 2 | Bi 208 | | | | |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | | | 7.14E-08 | CC 2 | Po 210 | | | | |
| Zn 65 | | | 1.62E-11 | CC 2 | Ra 223 | | | | |
| Se 79 | | | | | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | | 6.46E-08 | CC 2 | |
| Kr 85 | | | | | Ra 228 | | | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | | | 6.35E-07 | CC 2 | Th 227 | | | | |
| Zr 93 | | | | | Th 228 | | 4.50E-09 | CC 2 | |
| Nb 91 | | | | | Th 229 | | | | |
| Nb 92 | | | | | Th 230 | | 7.77E-09 | CC 2 | |
| Nb 93m | | | | | Th 232 | | 4.47E-09 | CC 2 | |
| Nb 94 | | | | | Th 234 | | | | |
| Mo 93 | | | | | Pa 231 | | | | |
| Tc 97 | | | | | Pa 233 | | | | |
| Tc 99 | | | 7.56E-08 | CC 2 | U 232 | | 2.24E-09 | CC 2 | |
| Ru 106 | | | 1.34E-08 | CC 2 | U 233 | | 1.23E-07 | CC 2 | |
| Pd 107 | | | | | U 234 | | 6.08E-07 | CC 2 | |
| Ag 108m | | | | | U 235 | | 1.09E-07 | CC 2 | |
| Ag 110m | | | 1.09E-11 | CC 2 | U 236 | | 6.88E-08 | CC 2 | |
| Cd 109 | | | | | U 238 | | 7.25E-07 | CC 2 | |
| Cd 113m | | | | | Np 237 | | 2.30E-08 | CC 2 | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | | 2.85E-08 | CC 2 | |
| Sn 123 | | | | | Pu 239 | | 5.90E-08 | CC 2 | |
| Sn 126 | | | | | Pu 240 | | 5.54E-08 | CC 2 | |
| Sb 125 | | | 3.83E-09 | CC 2 | Pu 241 | | 4.04E-07 | CC 2 | |
| Sb 126 | | | | | Pu 242 | | 1.15E-09 | CC 2 | |
| Te 125m | | | | | Am 241 | | 5.74E-08 | CC 2 | |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | 2.44E-08 | CC 2 | Am 243 | | | | |
| Cs 134 | | | 9.45E-09 | CC 2 | Cm 242 | | 5.25E-10 | CC 2 | |
| Cs 135 | | | | | Cm 243 | | 3.79E-10 | CC 2 | |
| Cs 137 | | | 7.59E-06 | CC 2 | Cm 244 | | 7.53E-09 | CC 2 | |
| Ba 133 | | | | | Cm 245 | | 6.66E-08 | CC 2 | |
| La 137 | | | | | Cm 246 | | 6.14E-09 | CC 2 | |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | | | 1.63E-08 | CC 2 | Cf 249 | | | | |
| Pm 145 | | | | | Cf 250 | | | | |
| Pm 147 | | | 3.07E-08 | CC 2 | Cf 251 | | | | |
| Sm 147 | | | | | Cf 252 | | | | |
| Sm 151 | | | 2.25E-10 | CC 2 | Other a | | | | |
| Eu 152 | | | 1.94E-11 | CC 2 | Other b/g | | | | |
| Eu 154 | | | 1.79E-09 | CC 2 | Total a | 0 | 2.02E-06 | CC 2 | |
| Eu 155 | | | 2.20E-09 | CC 2 | Total b/g | 0 | 1.12E-05 | CC 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