

| | | |
|---------------------|-------------|-----------------------------|
| WASTE STREAM | 2X33 | B205 Plutonium Areas |
|---------------------|-------------|-----------------------------|

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

WASTE VOLUMES

| | | Reported |
|------------------------|---------------------------|----------------------|
| Stocks: | At 1.4.2019..... | 0 m ³ |
| Future arisings - | 1.4.2019 - 31.3.2041..... | 265.0 m ³ |
| Total future arisings: | | 265.0 m ³ |
| Total waste volume: | | 265.0 m ³ |

Comment on volumes: Arisings are sourced from DEC-0828A and are based on the latest five-year forecasts from the Waste Forecasting database. The overall timescale for waste arising are informed by the Sellafield Site Master Timeline. Uncertainty information is notional.

| | | | | |
|---------------------------------|----------------|---|------------------|-------|
| Uncertainty factors on volumes: | Stock (upper): | x | Arisings (upper) | x 1.5 |
| | Stock (lower): | x | Arisings (lower) | x 0.5 |

WASTE SOURCE Waste is generated from routine plant operations from the Magnox Fuel Reprocessing plant Plutonium areas.

PHYSICAL CHARACTERISTICS

General description: The waste will include secondary wastes (such as PPE) and redundant plant items. The waste has not undergone any changes since it was generated.

Physical components (%vol): Metals (26.5%), Concrete/Rubble (3%), Soil (1%), Wood (2%), Rubber (1%), Halogenated Plastics (21%), Non-Halogenated Plastics (21%), Hydrocarbons (1%), Other Organics (23%), Asbestos (0.5%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.170

Comment on density: The total bulk density is derived from DEC-0828A and is based on lifetime mass and volume

CHEMICAL COMPOSITION

General description and components (%wt): Metals (26.5%), Concrete/Rubble (3%), Soil (1%), Wood (2%), Rubber (1%), Halogenated Plastics (21%), Non-Halogenated Plastics (21%), Hydrocarbons (1%), Other Organics (23%), Asbestos (0.5%).

Chemical state: -

Chemical form of radionuclides: -

Metals and alloys (%wt): -

| | |
|---------------------------|------|
| Stainless steel..... | 3.1 |
| Other ferrous metals..... | 8.4 |
| Iron..... | 7.1 |
| Aluminium..... | 1.8 |
| Beryllium..... | 0 |
| Cobalt..... | 0 |
| Copper..... | 0.88 |
| Lead..... | 4.4 |
| Magnox/Magnesium..... | 0 |
| Nickel..... | 0 |
| Titanium..... | 0 |
| Uranium..... | 0 |

WASTE STREAM**2X33****B205 Plutonium Areas**

| | | |
|-------------------------|-------------------------------------|------|
| | Zinc..... | 0.88 |
| | Zircaloy/Zirconium..... | 0 |
| | Other metals..... | 0 |
| Organics (%wt): | - | |
| | Total cellulose..... | 2.0 |
| | Paper, cotton..... | 0 |
| | Wood..... | 2.0 |
| | Halogenated plastics | 21.0 |
| | Total non-halogenated plastics..... | 21.0 |
| | Condensation polymers..... | 0 |
| | Others..... | 0 |
| | Organic ion exchange materials.... | 0 |
| | Total rubber..... | 1.0 |
| | Halogenated rubber | 0 |
| | Non-halogenated rubber..... | 0 |
| | Hydrocarbons..... | 0.97 |
| | Oil or grease | 0.44 |
| | Fuel..... | 0 |
| | Asphalt/Tarmac (cont.coal tar)... | 0.22 |
| | Asphalt/Tarmac (no coal tar)..... | 0.22 |
| | Bitumen..... | 0.09 |
| | Others..... | 0 |
| | Other organics..... | 22.9 |
| Other materials (%wt): | - | |
| | Inorganic ion exchange materials. | 0 |
| | Inorganic sludges and flocs..... | 0 |
| | Soil..... | 1.0 |
| | Brick/Stone/Rubble..... | 3.0 |
| | Cementitious material..... | 0 |
| | Sand..... | 0 |
| | Glass/Ceramics..... | 0 |
| | Graphite..... | 0 |
| | Desiccants/Catalysts..... | 0 |
| | Asbestos..... | 0.53 |
| | Non/low friable..... | 0.35 |
| | Moderately friable..... | 0.09 |
| | Highly friable..... | 0.09 |
| | Free aqueous liquids..... | 0 |
| | Free non-aqueous liquids..... | 0 |
| | Powder/Ash..... | 0 |
| Inorganic anions (%wt): | - | |

WASTE STREAM**2X33****B205 Plutonium Areas**

| | |
|----------------|---|
| 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:

| | |
|--|------|
| - | |
| Combustible metals..... | 0 |
| Low flash point liquids..... | 0 |
| Explosive materials..... | 0 |
| Phosphorus..... | 0 |
| Hydrides..... | 0 |
| Biological etc. materials..... | 0 |
| Biodegradable materials..... | 22.0 |
| Putrescible wastes..... | 1.0 |
| Non-putrescible wastes..... | 21.0 |
| Corrosive materials..... | 0 |
| Pyrophoric materials..... | 0 |
| Generating toxic gases..... | 0 |
| Reacting with water..... | 0 |
| Active particles..... | 0 |
| Soluble solids as bulk chemical compounds..... | 0 |

Hazardous substances / non hazardous pollutants:

| | |
|-----------------------------|---|
| - | |
| Acrylamide..... | 0 |
| Benzene..... | 0 |
| Chlorinated solvents..... | 0 |
| Formaldehyde..... | 0 |
| Organometallics..... | 0 |
| Phenol..... | 0 |
| Styrene..... | 0 |
| Tri-butyl phosphate..... | 0 |
| Other organophosphates..... | 0 |
| Vinyl chloride..... | 0 |
| Arsenic..... | 0 |
| Barium..... | 0 |
| Boron..... | 0 |

WASTE STREAM**2X33****B205 Plutonium Areas**

| | |
|---------------------------------------|-----------------------------------|
| Cadmium..... | 0 |
| Caesium..... | 0 |
| Selenium..... | 0 |
| Chromium..... | 0 |
| Molybdenum..... | 0 |
| Thallium..... | 0 |
| Tin..... | 0.88 |
| Vanadium..... | 0 |
| Mercury compounds..... | 0 |
| Others..... | 0 |
| Electronic Electrical Equipment (EEE) | |
| EEE Type 1..... | P 250 items. |
| EEE Type 2..... | P 200 items. |
| EEE Type 3..... | P 200 items. |
| EEE Type 4..... | P 200 items. |
| EEE Type 5..... | P 100 items. |

Complexing agents (%wt):

| | |
|--------------------------------|-------|
| Yes | |
| EDTA..... | <0.01 |
| DPTA..... | 0 |
| NTA..... | 0 |
| Polycarboxylic acids..... | 0 |
| Other organic complexants..... | 0 |
| Total complexing agents..... | <0.01 |

TREATMENT, PACKAGING AND DISPOSAL

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

| Treatment | On-site / Off site | Stream volume % |
|-----------------------|--------------------|-----------------|
| Low force compaction | On-site | 97.1 |
| Supercompaction (HFC) | | |
| Incineration | Off-site | 2.1 |
| Solidification | | |
| Decontamination | | |
| Metal treatment | | |
| Size reduction | | |
| Decay storage | | |
| Recycling / reuse | | |
| Other / various | 0.80 | |
| None | | |

Comment on planned treatments:

All high force compaction takes place in WAMAC. For Inventory purposes, it is assumed that supercompaction will continue after the closure of WAMAC in 2028. Metal treatment will take place off-site. Waste not requiring treatment is mostly 'out of scope' metal, VLLW and direct disposal to LLWR.

WASTE STREAM**2X33****B205 Plutonium Areas****Disposal Routes:**

| Disposal Route | Stream volume % | |
|--|-----------------|-----|
| Expected to be consigned to the LLW Repository | 97.9 | |
| 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 | | 2.1 |
| 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 | 97.1 | 59.28 | 5 |
| 1/2 Height IP-2 Disposal/Re-usable ISO | 0.80 | 10 | < 1 |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other | | | |

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

Waste Characterisation Form (WCH):

The waste meets the LLWR's Waste Acceptance Criteria (WAC).
 The waste has a current WCH.
 Differences exist between Inventory information and current WCH.
 Materials and radioactivity data has been taken from the current WCH, but data on waste volumes and waste routes is based on the Waste Forecasting database as this information is more recent.

Waste consigned for disposal to LLWR in year of generation:

Yes.

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: -

WASTE STREAM**2X33****B205 Plutonium Areas**

Other information:

-

RADIOACTIVITY

Source:

The activity arises from the reprocessing of Magnox fuel. The waste is contaminated as a result of routine operations.

Uncertainty:

The uncertainty associated with the derived fingerprint is likely to be relatively low, however the volumes and total activity information (and possibly some other assumptions) are likely to be more notional and thus more uncertain.

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:

Specific activity data is based on data in the corresponding WCH, which in turn maps an estimated total activity to an analytically derived radionuclide fingerprint.

Other information:

The radionuclides have been taken from DEC-0828A and are based on the current WCH.

WASTE STREAM

2X33

B205 Plutonium Areas

| 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 | | | 1.82E-07 | C C 2 | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | | | 2.98E-08 | C C 2 | Ho 166m | | | | |
| Na 22 | | | | | Tm 170 | | | | |
| Al 26 | | | | | Tm 171 | | | | |
| Cl 36 | | | | | 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 | | | | | Pb 210 | | | | |
| Co 60 | | | | | Bi 208 | | | | |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | | | | | Po 210 | | | | |
| Zn 65 | | | | | Ra 223 | | | | |
| Se 79 | | | | | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | | | | |
| Kr 85 | | | | | Ra 228 | | | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | | | 4.73E-07 | 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 | | | 2.52E-07 | C C 2 | U 232 | | | | |
| Ru 106 | | | | | U 233 | | | | |
| Pd 107 | | | | | U 234 | | 3.64E-08 | C C 2 | |
| Ag 108m | | | | | U 235 | | 3.31E-09 | C C 2 | |
| Ag 110m | | | | | U 236 | | | | |
| Cd 109 | | | | | U 238 | | 3.31E-08 | C C 2 | |
| Cd 113m | | | | | Np 237 | | | | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | | 1.30E-06 | C C 2 | |
| Sn 123 | | | | | Pu 239 | | 2.31E-06 | C C 2 | |
| Sn 126 | | | | | Pu 240 | | 2.31E-06 | C C 2 | |
| Sb 125 | | | | | Pu 241 | | 2.09E-05 | C C 2 | |
| Sb 126 | | | | | Pu 242 | | | | |
| Te 125m | | | | | Am 241 | | 5.08E-06 | C C 2 | |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | | | Am 243 | | | | |
| Cs 134 | | | | | Cm 242 | | 3.97E-08 | C C 2 | |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | | | 1.06E-07 | C C 2 | Cm 244 | | 6.29E-08 | 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 | 0 | 1.12E-05 | C C 2 | |
| Eu 155 | | | | | Total b/g | 0 | 2.19E-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