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|---------------------|--------------|------------------------------|
| WASTE STREAM | 9A320 | Contaminated Soil LLW |
|---------------------|--------------|------------------------------|

SITE Berkeley

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE LLW

WASTE VOLUMES

| | | Reported |
|------------------------|---------------------------|----------------------|
| Stocks: | At 1.4.2019..... | 0 m ³ |
| Future arisings - | 1.4.2074 - 31.3.2077..... | 159.9 m ³ |
| Total future arisings: | | 159.9 m ³ |
| Total waste volume: | | 159.9 m ³ |

Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 3 years. Final Dismantling & Site Clearance is assumed to commence in 2070 with reactor dismantling commencing in 2074 and lasting for 3 years. The volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2074.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.2
 Stock (lower): x Arisings (lower) x 0.8

WASTE SOURCE Contaminated soil that has resulted from plant operation and maintenance.

PHYSICAL CHARACTERISTICS

General description: Based on made ground and upper natural material descriptions: Grey fine to coarse sand matrix with crushed concrete, brick rubble fill, and an orangy brown firm to stiff clay with fragments of mudstone. Possible large concrete fragments (0.2m to 0.5m long axis). Possible occasional tarmac pieces (0.5m long axis).

Physical components (%vol): Sand (50%), Clay (20%), Concrete fragments (10%), Mudstone fragments (10%), Limestone/flint/brick rubble (10%).

Sealed sources: -

Bulk density (t/m³): ~1.75

Comment on density: The bulk density is an estimate and may be subject to revision. Assumes a bulkage factor (physical expansion) of 1.3.

CHEMICAL COMPOSITION

General description and components (%wt): Soil, rubble, organic material and water. Percentages are not estimated.

Chemical state: Alkali

Chemical form of radionuclides: Cl-36: The chlorine 36 content is insignificant.

Metals and alloys (%wt): There are no bulk or sheet metal items present in the waste.

| | |
|---------------------------|----|
| Stainless steel..... | 0 |
| Other ferrous metals..... | 0 |
| Iron..... | |
| Aluminium..... | 0 |
| Beryllium..... | NE |
| Cobalt..... | |
| Copper..... | 0 |
| Lead..... | 0 |
| Magnox/Magnesium..... | 0 |
| Nickel..... | |
| Titanium..... | |
| Uranium..... | |

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Zinc..... 0

Zircaloy/Zirconium..... 0

Other metals..... 0

"Other" metals are not expected
except in their oxide form.

Organics (%wt):

Organic matter will be associated with the soil. Halogenated plastics or rubbers are not
expected.

Total cellulosics..... NE

Paper, cotton..... NE

Wood..... NE

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..... TR

Oil or grease

Fuel.....

Asphalt/Tarmac (cont.coal tar)... TR

Asphalt/Tarmac (no coal tar).... TR

Bitumen.....

Others.....

Other organics..... NE

Other materials (%wt):

-

Inorganic ion exchange materials. 0

Inorganic sludges and flocs..... 0

Soil..... ~80.0

Brick/Stone/Rubble..... ~20.0

Cementitious material..... 0

Sand.....

Glass/Ceramics..... 0

Graphite..... 0

Desiccants/Catalysts.....

Asbestos..... 0

Non/low friable.....

Moderately friable.....

Highly friable.....

Free aqueous liquids..... NE

Free non-aqueous liquids..... 0

Powder/Ash..... 0

Inorganic anions (%wt):

Anion content not fully determined. The anion content of the waste is naturally occurring
oxides expected in soil.

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

There will be water associated with the waste. There may be traces of biological material.

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

Hazardous substances / non hazardous pollutants:

Any toxic metal content would be at the natural incidence for the type of soil.

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

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Cadmium.....
 Caesium.....
 Selenium.....
 Chromium.....
 Molybdenum.....
 Thallium.....
 Tin.....
 Vanadium.....
 Mercury compounds.....
 Others.....
 Electronic Electrical Equipment (EEE)
 EEE Type 1.....
 EEE Type 2.....
 EEE Type 3.....
 EEE Type 4.....
 EEE Type 5.....

Complexing agents (%wt):

EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... NE

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:

-

WASTE STREAM**9A320****Contaminated Soil LLW****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: (Not applicable to this waste stream)

| 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 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

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| | |
|---|---|
| Source: | Contamination that has resulted from plant maintenance and operation. Cs-137 is expected to dominate. |
| Uncertainty: | Only approximate estimates have been made of the total specific activities. The activity may vary either way by a factor of 10. The activities quoted are those at the time of final site decommissioning. |
| 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: | Provision of detailed data will have to await detailed site characterisation. Total alpha activities are expected to be of the order 1E-8 TBq/m ³ . |
| Other information: | The activities quoted are those at 85 years after reactor shutdown, i.e. in 2074. This change has been made to reflect LTP08 Rev D FSC decommissioning timescales. No radionuclides other than those listed are expected to be significant. |

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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 | | | | 8 | Gd 153 | | | | 8 |
| Be 10 | | | | 8 | Ho 163 | | | | 8 |
| C 14 | | | | 8 | 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 | | | | 8 | Tl 204 | | | | 8 |
| Mn 54 | | | | 8 | Pb 205 | | | | 8 |
| Fe 55 | | | | 8 | Pb 210 | | | | 8 |
| Co 60 | | | | 8 | Bi 208 | | | | 8 |
| Ni 59 | | | | 8 | Bi 210m | | | | 8 |
| Ni 63 | | | | 8 | Po 210 | | | | 8 |
| Zn 65 | | | | 8 | Ra 223 | | | | 8 |
| Se 79 | | | | 8 | Ra 225 | | | | 8 |
| Kr 81 | | | | 8 | Ra 226 | | | | 8 |
| Kr 85 | | | | 8 | Ra 228 | | | | 8 |
| Rb 87 | | | | 8 | Ac 227 | | | | 8 |
| Sr 90 | | | | 6 | Th 227 | | | | 8 |
| Zr 93 | | | | 8 | Th 228 | | | | 8 |
| Nb 91 | | | | 8 | Th 229 | | | | 8 |
| Nb 92 | | | | 8 | Th 230 | | | | 8 |
| Nb 93m | | | | 8 | Th 232 | | | | 8 |
| Nb 94 | | | | 8 | Th 234 | | | | 8 |
| Mo 93 | | | | 8 | Pa 231 | | | | 8 |
| Tc 97 | | | | 8 | Pa 233 | | | | 8 |
| Tc 99 | | | | 8 | U 232 | | | | 8 |
| Ru 106 | | | | 8 | U 233 | | | | 8 |
| Pd 107 | | | | 8 | U 234 | | | | 8 |
| Ag 108m | | | | 8 | U 235 | | | | 8 |
| Ag 110m | | | | 8 | U 236 | | | | 8 |
| Cd 109 | | | | 8 | U 238 | | | | 8 |
| Cd 113m | | | | 8 | Np 237 | | | | 8 |
| Sn 119m | | | | 8 | Pu 236 | | | | 8 |
| Sn 121m | | | | 8 | Pu 238 | | | | 6 |
| Sn 123 | | | | 8 | Pu 239 | | | | 6 |
| Sn 126 | | | | 8 | Pu 240 | | | | 6 |
| Sb 125 | | | | 8 | Pu 241 | | | | 8 |
| Sb 126 | | | | 8 | Pu 242 | | | | 8 |
| Te 125m | | | | 8 | Am 241 | | | | 6 |
| Te 127m | | | | 8 | Am 242m | | | | 8 |
| I 129 | | | | 8 | Am 243 | | | | 8 |
| Cs 134 | | | | 8 | Cm 242 | | | | 8 |
| Cs 135 | | | | 8 | Cm 243 | | | | 8 |
| Cs 137 | | | 1.6E-06 | CC 2 | Cm 244 | | | | 8 |
| Ba 133 | | | | 8 | Cm 245 | | | | 8 |
| 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 | | | | 8 | Total a | 0 | | 0 | |
| Eu 155 | | | | 8 | Total b/g | 0 | | 1.6E-06 | 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