

WASTE STREAM**3M19****Reactors and Dry Fuel Route - Low Level Waste****SITE** Heysham 2**SITE OWNER** EDFE NGL**WASTE CUSTODIAN** EDFE NGL**WASTE TYPE** LLW**WASTE VOLUMES**

| | | Reported |
|------------------------|---------------------------|----------------------|
| Stocks: | At 1.4.2019..... | 19.8 m ³ |
| Future arisings - | 1.4.2019 - 31.3.2029..... | 24.5 m ³ |
| | 1.4.2029 - 31.3.2030..... | 16.6 m ³ |
| | 1.4.2030 - 31.3.2031..... | 66.4 m ³ |
| | 1.4.2031 - 31.3.2032..... | 68.6 m ³ |
| | 1.4.2032 - 31.3.2033..... | 71.4 m ³ |
| | 1.4.2033 - 31.3.2034..... | 73.5 m ³ |
| | 1.4.2034 - 31.3.2035..... | 30.9 m ³ |
| | 1.4.2035 - 31.3.2040..... | 0 m ³ |
| | 1.4.2040 - 31.3.2041..... | 4.3 m ³ |
| Total future arisings: | | 356.2 m ³ |
| Total waste volume: | | 376.0 m ³ |

Comment on volumes: Waste volumes will be variable depending on station operating conditions.

Uncertainty factors on volumes: Stock (upper): x 1.25 Arisings (upper) x 1.5
 Stock (lower): x 0.75 Arisings (lower) x 0.5

WASTE SOURCE General solid LLW arisings from Reactor Building.**PHYSICAL CHARACTERISTICS**

General description: The waste is solids such as paper, plastics, rubber, metal and clothing that is slightly contaminated. There may also be filters and redundant equipment. There may be large items in the waste that may require special handling in the future.

Physical components (%wt): Metals (~10%), Organics (inc. paper, cloth and wood, ~48%), Plastic/Rubber (~39%), Concrete/Soil (~2%) and other waste (e.g. glass/lagging) (~1%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.3

Comment on density: Density based on conditioned volume in WCF.

CHEMICAL COMPOSITION

General description and components (%wt): Metals (~10%), Organics (inc. paper, cloth and wood, ~48%), Plastic/Rubber (~39%), Concrete/Soil (~2%) and other waste (e.g. glass/lagging) (~1%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritiated water
 C-14: Contamination by activated graphite and metallic particulate
 Cl-36: To be determined
 Se-79: Not expected to be significant
 Tc-99: Not expected to be significant
 I-129: To be determined
 Ra: Not expected to be significant
 Th: Not expected to be significant
 U: To be determined
 Np: Not expected to be significant
 Pu: To be determined

Metals and alloys (%wt): -

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| | | |
|------------------------|-------------------------------------|-------|
| | Stainless steel..... | ~8.0 |
| | Other ferrous metals..... | ~2.0 |
| | Iron..... | NE |
| | Aluminium..... | NE |
| | Beryllium..... | NE |
| | Cobalt..... | NE |
| | Copper..... | NE |
| | Lead..... | 0 |
| | Magnox/Magnesium..... | NE |
| | Nickel..... | NE |
| | Titanium..... | NE |
| | Uranium..... | NE |
| | Zinc..... | NE |
| | Zircaloy/Zirconium..... | NE |
| | Other metals..... | NE |
| Organics (%wt): | To be further assessed. | |
| | Total cellulose..... | ~48.0 |
| | Paper, cotton..... | ~40.0 |
| | Wood..... | ~8.0 |
| | Halogenated plastics | ~5.0 |
| | Total non-halogenated plastics..... | ~25.0 |
| | Condensation polymers..... | NE |
| | Others..... | ~25.0 |
| | Organic ion exchange materials.... | 0 |
| | Total rubber..... | ~9.0 |
| | Halogenated rubber | NE |
| | Non-halogenated rubber..... | ~9.0 |
| | Hydrocarbons..... | NE |
| | Oil or grease | NE |
| | Fuel..... | |
| | Asphalt/Tarmac (cont.coal tar)... | |
| | Asphalt/Tarmac (no coal tar).... | |
| | Bitumen..... | |
| | Others..... | |
| | Other organics..... | NE |
| Other materials (%wt): | - | |
| | Inorganic ion exchange materials. | 0 |
| | Inorganic sludges and flocs..... | 0 |
| | Soil..... | ~1.0 |
| | Brick/Stone/Rubble..... | 0 |
| | Cementitious material..... | ~1.0 |
| | Sand..... | 0 |
| | Glass/Ceramics..... | ~1.0 |

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| | | | |
|--|--|----|--------------|
| | Graphite..... | 0 | |
| | Desiccants/Catalysts..... | 0 | |
| | Asbestos..... | 0 | |
| | Non/low friable..... | | |
| | Moderately friable..... | | |
| | Highly friable..... | | |
| | Free aqueous liquids..... | 0 | |
| | Free non-aqueous liquids..... | 0 | |
| | Powder/Ash..... | 0 | |
| Inorganic anions (%wt): | Inorganic anions likely to be below 1% of waste, but not assessed. | | |
| | 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: | Some of the materials in the waste would burn under appropriate conditions and plastics and rubber could generate toxic fumes. | | |
| | 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..... | | |
| | Corrosive materials..... | 0 | |
| | Pyrophoric materials..... | 0 | |
| | Generating toxic gases..... | 0 | |
| | Reacting with water..... | 0 | |
| | Active particles..... | 0 | Not expected |
| | Soluble solids as bulk chemical compounds..... | 0 | |
| Hazardous substances / non hazardous pollutants: | - | | |
| | Acrylamide..... | NE | |
| | Benzene..... | NE | |
| | Chlorinated solvents..... | NE | |

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| | |
|---------------------------------------|----|
| Formaldehyde..... | NE |
| Organometallics..... | NE |
| Phenol..... | NE |
| Styrene..... | NE |
| Tri-butyl phosphate..... | NE |
| Other organophosphates..... | NE |
| Vinyl chloride..... | NE |
| Arsenic..... | NE |
| Barium..... | NE |
| Boron..... | NE |
| Cadmium..... | NE |
| Caesium..... | NE |
| Selenium..... | NE |
| Chromium..... | NE |
| Molybdenum..... | NE |
| Thallium..... | NE |
| Tin..... | NE |
| Vanadium..... | NE |
| Mercury compounds..... | 0 |
| Others..... | NE |
| Electronic Electrical Equipment (EEE) | |
| EEE Type 1..... | NE |
| EEE Type 2..... | NE |
| EEE Type 3..... | NE |
| EEE Type 4..... | NE |
| EEE Type 5..... | NE |
| Complexing agents (%wt): | No |
| EDTA..... | NE |
| DPTA..... | NE |
| NTA..... | NE |
| Polycarboxylic acids..... | NE |
| Other organic complexants..... | NE |
| Total complexing agents..... | 0 |

TREATMENT, PACKAGING AND DISPOSAL

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

| Treatment | On-site / Off site | Stream volume % |
|-----------------------|--------------------|-----------------|
| Low force compaction | | |
| Supercompaction (HFC) | Off-site | ~20.0 |
| Incineration | Off-site | ~50.0 |
| Solidification | On-site | <10.0 |
| Decontamination | On-site | ~5.0 |
| Metal treatment | | |
| Size reduction | | |
| Decay storage | | |
| Recycling / reuse | | |
| Other / various | | |
| None | | ~15.0 |

Comment on planned treatments:

In line with the waste hierarchy, wastes will be treated preferentially by incineration, metal decontamination/melting, supercompaction, optimal packaging in HHISOs or immobilisation by encapsulation where necessary, prior to ultimate disposal at the LLW Repository. These treatments will be carried out off-site under contract with companies such as LLWR Ltd, EDF Cyclife, Tradebe and Inutec. The percentages are based on the history of consignments across the fleet of EDF Energy Nuclear Generation stations.

Disposal Routes:

| Disposal Route | Stream volume % |
|--|-----------------|
| Expected to be consigned to the LLW Repository | 45.0 |
| 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 | 50.0 |
| Expected to be consigned to a Metal Treatment Facility | |
| Expected to be consigned as Out of Scope | |
| Expected to be recycled / reused | 5.0 |
| 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 | | | |
| 1/2 Height IP-2 Disposal/Re-usable ISO | 45.0 | ~13.55 | 13 |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other | | | |

Other information:

Waste loading is representative of the raw waste following further planned treatments. The waste will be reduced to 50% of its original waste volume after further planned treatments.

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| | |
|---|--|
| Container voidage: | - |
| Waste Characterisation Form (WCH): | The waste meets the LLWR's Waste Acceptance Criteria (WAC). The waste has a current WCH. Inventory information is consistent with the current WCH. |
| Waste consigned for disposal to LLWR in year of generation: | Yes. |
| Potential for the waste to contain discrete items: | Yes |

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: | Principally activation products. |
| Uncertainty: | - |
| 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: | Activity estimates are based on fingerprint of waste stream . |
| Other information: | - |

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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 | 7.88E-05 | CC 2 | 7.88E-05 | CC 2 | Gd 153 | | | | |
| Be 10 | | 8 | | 8 | Ho 163 | | | | |
| C 14 | 1.37E-05 | CC 2 | 1.37E-05 | CC 2 | Ho 166m | | | | |
| Na 22 | | 4 | | 4 | Tm 170 | | | | |
| Al 26 | | 4 | | 4 | Tm 171 | | | | |
| Cl 36 | 1.68E-05 | CC 2 | 1.68E-05 | CC 2 | Lu 174 | | | | |
| Ar 39 | | | | | Lu 176 | | | | |
| Ar 42 | | | | | Hf 178n | | | | |
| K 40 | | | | | Hf 182 | | | | |
| Ca 41 | | 8 | | 8 | Pt 193 | | | | |
| Mn 53 | | | | | Tl 204 | | | | |
| Mn 54 | 1.72E-05 | CC 2 | 1.72E-05 | CC 2 | Pb 205 | | | | |
| Fe 55 | 1.17E-03 | CC 2 | 1.17E-03 | CC 2 | Pb 210 | | 8 | | 8 |
| Co 60 | 1.75E-04 | CC 2 | 1.75E-04 | CC 2 | Bi 208 | | | | |
| Ni 59 | | 8 | | 8 | Bi 210m | | | | |
| Ni 63 | 9.45E-05 | CC 2 | 9.45E-05 | CC 2 | Po 210 | | 8 | | 8 |
| Zn 65 | 1.52E-06 | CC 2 | 1.52E-06 | CC 2 | Ra 223 | | | | |
| Se 79 | | 8 | | 8 | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | | 8 | | 8 |
| Kr 85 | | | | | Ra 228 | | | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | 1.24E-07 | CC 2 | 1.24E-07 | CC 2 | Th 227 | | | | |
| Zr 93 | | 8 | | 8 | Th 228 | | | | |
| Nb 91 | | | | | Th 229 | | 8 | | 8 |
| Nb 92 | | | | | Th 230 | | 8 | | 8 |
| Nb 93m | | 8 | | 8 | Th 232 | | 8 | | 8 |
| Nb 94 | 4.73E-08 | CC 2 | 4.73E-08 | CC 2 | Th 234 | | | | |
| Mo 93 | | 8 | | 8 | Pa 231 | | 8 | | 8 |
| Tc 97 | | | | | Pa 233 | | | | |
| Tc 99 | | 8 | | 8 | U 232 | | | | |
| Ru 106 | 7.35E-08 | CC 2 | 7.35E-08 | CC 2 | U 233 | | 8 | | 8 |
| Pd 107 | | 8 | | 8 | U 234 | 7.35E-09 | CC 2 | 7.35E-09 | CC 2 |
| Ag 108m | 4.38E-08 | CC 2 | 4.38E-08 | CC 2 | U 235 | 4.2E-10 | CC 2 | 4.2E-10 | CC 2 |
| Ag 110m | 1.31E-06 | CC 2 | 1.31E-06 | CC 2 | U 236 | 6.65E-09 | CC 2 | 6.65E-09 | CC 2 |
| Cd 109 | | | | | U 238 | 1.17E-08 | CC 2 | 1.17E-08 | CC 2 |
| Cd 113m | | | | | Np 237 | | 8 | | 8 |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | 8 | | 8 | Pu 238 | 1.02E-09 | CC 2 | 1.02E-09 | CC 2 |
| Sn 123 | | | | | Pu 239 | 5.43E-09 | CC 2 | 5.43E-09 | CC 2 |
| Sn 126 | | 8 | | 8 | Pu 240 | 1.30E-08 | CC 2 | 1.30E-08 | CC 2 |
| Sb 125 | 1.05E-07 | CC 2 | 1.05E-07 | CC 2 | Pu 241 | 5.78E-07 | CC 2 | 5.78E-07 | CC 2 |
| Sb 126 | | | | | Pu 242 | | 8 | | 8 |
| Te 125m | | | | | Am 241 | 1.05E-08 | CC 2 | 1.05E-08 | CC 2 |
| Te 127m | | | | | Am 242m | | 8 | | 8 |
| I 129 | 3.33E-14 | CC 2 | 3.33E-14 | CC 2 | Am 243 | | 8 | | 8 |
| Cs 134 | 2.28E-07 | CC 2 | 2.28E-07 | CC 2 | Cm 242 | 8.93E-09 | CC 2 | 8.93E-09 | CC 2 |
| Cs 135 | | 8 | | 8 | Cm 243 | 8.75E-11 | CC 2 | 8.75E-11 | CC 2 |
| Cs 137 | 1.26E-07 | CC 2 | 1.26E-07 | CC 2 | Cm 244 | 6.13E-09 | CC 2 | 6.13E-09 | CC 2 |
| Ba 133 | 3.33E-08 | CC 2 | 3.33E-08 | CC 2 | Cm 245 | | 8 | | 8 |
| La 137 | | | | | Cm 246 | | 8 | | 8 |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | 2.1E-07 | CC 2 | 2.1E-07 | CC 2 | Cf 249 | | | | |
| Pm 145 | | | | | Cf 250 | | | | |
| Pm 147 | 9.63E-07 | CC 2 | 9.63E-07 | CC 2 | Cf 251 | | | | |
| Sm 147 | | | | | Cf 252 | | | | |
| Sm 151 | | | | | Other a | | 8 | | 8 |
| Eu 152 | 7.35E-08 | CC 2 | 7.35E-08 | CC 2 | Other b/g | 1.69E-04 | CC 2 | 1.69E-04 | CC 2 |
| Eu 154 | 1.12E-07 | CC 2 | 1.12E-07 | CC 2 | Total a | 7.12E-08 | CC 2 | 7.12E-08 | CC 2 |
| Eu 155 | 8.05E-08 | CC 2 | 8.05E-08 | CC 2 | Total b/g | 1.74E-03 | CC 2 | 1.74E-03 | 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