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| WASTE STREAM | 2X302/7 | Fuel Element Storage and Handling LLW |
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SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE LLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

| | | Reported |
|---------------------------------|---|------------------------|
| Stocks: | At 1.4.2022..... | 0 m ³ |
| Future arisings - | 1.4.2022 - 31.3.2023..... | 21.6 m ³ |
| | 1.4.2023 - 31.3.2024..... | 57.0 m ³ |
| | 1.4.2024 - 31.3.2025..... | 30.7 m ³ |
| | 1.4.2025 - 31.3.2026..... | 30.7 m ³ |
| | 1.4.2026 - 31.3.2027..... | 30.7 m ³ |
| | 1.4.2027 - 31.3.2028..... | 30.7 m ³ |
| | 1.4.2028 - 31.3.2029..... | 30.7 m ³ |
| | 1.4.2029 - 31.3.2030..... | 30.7 m ³ |
| | 1.4.2030 - 31.3.2031..... | 30.7 m ³ |
| | 1.4.2031 - 31.3.2032..... | 30.7 m ³ |
| | 1.4.2032 - 31.3.2033..... | 30.7 m ³ |
| | 1.4.2033 - 31.3.2034..... | 30.7 m ³ |
| | 1.4.2034 - 31.3.2035..... | 30.7 m ³ |
| | 1.4.2035 - 31.3.2036..... | 30.7 m ³ |
| | 1.4.2036 - 31.3.2037..... | 30.7 m ³ |
| | 1.4.2037 - 31.3.2038..... | 30.7 m ³ |
| | 1.4.2038 - 31.3.2039..... | 30.7 m ³ |
| | 1.4.2039 - 31.3.2040..... | 30.7 m ³ |
| | 1.4.2040 - 31.3.2041..... | 30.7 m ³ |
| | 1.4.2041 - 31.3.2042..... | 30.7 m ³ |
| | 1.4.2042 - 31.3.2043..... | 30.7 m ³ |
| Total future arisings: | | 661.7 m ³ |
| Total waste volume: | | 661.7 m ³ |
| Comment on volumes: | Arisings are sourced from REM_TP_0116A 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 arises from this facility due to the disposal of redundant equipment and maintenance activities. The facility is in the process of being decommissioned.

PHYSICAL CHARACTERISTICS

General description: The waste is mostly secondary waste and some quantities of hard waste associated with plant items and the building fabric. The waste has not undergone any changes since it was generated.

Physical components (%wt): Metals (50.1%), Concrete/Rubble (1.6%), Wood (1%), Rubber (1%), Halogenated Plastics (5.4%), Non-Halogenated Plastics (5.4%), Hydrocarbons (0.9%), Other Organics (3%), Asbestos (28.5%) and Other (3.1%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.822

Comment on density: The total bulk density is derived from REM_TP_0116A and based on lifetime mass and volume.

CHEMICAL COMPOSITION

General description and components (%wt): Metals (50.1%), Concrete/Rubble (1.6%), Wood (1%), Rubber (1%), Halogenated Plastics (5.4%), Non-Halogenated Plastics (5.4%), Hydrocarbons (0.9%), Other Organics (3%),

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Asbestos (28.5%) and Other (3.1%).

Chemical state: Neutral

Chemical form of radionuclides: -

Metals and alloys (%wt): Metal thickness not specified

| | (%wt) | Type(s) / Grade(s) with proportions | % of total C14 activity |
|---------------------------|-------|-------------------------------------|-------------------------|
| Stainless steel..... | 10.7 | | |
| Other ferrous metals..... | 15.0 | | |
| Iron..... | 0.54 | | |
| Aluminium..... | 0.75 | | |
| Beryllium..... | 0 | | |
| Cobalt..... | 0 | | |
| Copper..... | 0.19 | | |
| Lead..... | 21.5 | | |
| Magnox/Magnesium..... | 0 | | |
| Nickel..... | 0 | | |
| Titanium..... | 0 | | |
| Uranium..... | 0 | | |
| Zinc..... | 1.4 | | |
| Zircaloy/Zirconium..... | 0 | | |
| Other metals..... | 0 | | |

Organics (%wt): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|-------------------------------------|-------|---------------------|-------------------------|
| Total cellulose..... | 1.0 | | |
| Paper, cotton..... | 0 | | |
| Wood..... | 1.0 | | |
| Halogenated plastics | 5.4 | | |
| Total non-halogenated plastics..... | 5.4 | | |
| Condensation polymers..... | 0 | | |
| Others..... | 0 | | |
| Organic ion exchange materials.... | 0 | | |
| Total rubber..... | 1.0 | | |
| Halogenated rubber | 0 | | |
| Non-halogenated rubber..... | 0 | | |
| Hydrocarbons..... | 0.86 | | |
| Oil or grease | 0 | | |
| Fuel..... | 0 | | |
| Asphalt/Tarmac (cont.coal tar)... | 0 | | |
| Asphalt/Tarmac (no coal tar).... | 0 | | |
| Bitumen..... | 0.86 | | |
| Others..... | 0 | | |
| Other organics..... | 3.0 | | |

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Other materials (%wt): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|------------------------------------|-------|---------------------|-------------------------|
| Inorganic ion exchange materials.. | 0 | | |
| Inorganic sludges and flocs..... | 0 | | |
| Soil..... | 0 | | |
| Brick/Stone/Rubble..... | 1.6 | | |
| Cementitious material..... | 1.0 | | |
| Sand..... | 0 | | |
| Glass/Ceramics..... | 2.1 | | |
| Graphite..... | 0 | | |
| Desiccants/Catalysts..... | 0 | | |
| Asbestos..... | 28.5 | | |
| Non/low friable..... | 25.7 | | |
| Moderately friable..... | 2.1 | | |
| Highly friable..... | 0.64 | | |
| Free aqueous liquids..... | 0 | | |
| Free non-aqueous liquids..... | 0 | | |
| Powder/Ash..... | 0 | | |

Inorganic anions (%wt): -

| | (%wt) | Type(s) and comment |
|----------------|-------|---------------------|
| 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: -

| | (%wt) | Type(s) and comment |
|--------------------------------|-------|---------------------|
| Combustible metals..... | 0 | |
| Low flash point liquids..... | 0 | |
| Explosive materials..... | 0 | |
| Phosphorus..... | 0 | |
| Hydrides..... | 0 | |
| Biological etc. materials..... | 0 | |
| Biodegradable materials..... | 3.0 | |
| Putrescible wastes..... | 1.0 | |

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| Non-putrescible wastes..... | 2.0 |
| Corrosive materials..... | 0 |
| Pyrophoric materials..... | 0 |
| Generating toxic gases..... | 0 |
| Reacting with water..... | 2.2 |
| Higher activity particles..... | 0 |
| Soluble solids as bulk chemical compounds..... | 0 |

Hazardous substances /
non hazardous pollutants: -

| | (%wt) | Type(s) and comment |
|---------------------------------------|-------|------------------------|
| 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 | |
| Boron (in Boral)..... | 0 | |
| Boron (non-Boral)..... | 0 | |
| Cadmium..... | 0 | |
| Caesium..... | 0 | |
| Selenium..... | 0 | |
| Chromium..... | 0 | |
| Molybdenum..... | 0 | |
| Thallium..... | 0 | |
| Tin..... | 0 | |
| Vanadium..... | 0 | |
| Mercury compounds..... | 0 | |
| Others..... | 0 | |
| Electronic Electrical Equipment (EEE) | | |
| EEE Type 1..... | | 70 items over 5 years. |
| EEE Type 2..... | | 25 items over 5 years. |
| EEE Type 3..... | | 50 items over 5 years. |
| EEE Type 4..... | | 50 items over 5 years. |
| EEE Type 5..... | | 25 items over 5 years. |

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Complexing agents (%wt): Yes

| | (%wt) | Type(s) and comment |
|--------------------------------|-------|---------------------|
| EDTA..... | <0.01 | |
| DPTA..... | 0 | |
| NTA..... | 0 | |
| Polycarboxylic acids..... | 0 | |
| Other organic complexants..... | 0 | |
| Total complexing agents..... | <0.01 | |

Potential for the waste to contain discrete items: Yes. Metal sheets and channels, pumps, motors.

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 | 22.8 |
| Incineration | Off-site | 22.8 |
| Solidification | | |
| Decontamination | | |
| Metal treatment | Off-site | 44.2 |
| Size reduction | | |
| Decay storage | | |
| Recycling / reuse | | |
| Other / various | | |
| None | | 10.3 |

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. Waste not requiring treatment is 'out of scope' metal, VLLW or direct disposal to LLWR.

Disposal Routes:

| Disposal Route | Stream volume % | Disposal density t/m3 |
|--|-----------------|-----------------------|
| Expected to be consigned to the LLW Repository | 26.6 | 0.29 |
| Expected to be consigned to a Landfill Facility | | |
| Expected to be consigned to an On-Site Disposal Facility | 5.9 | 1.5 |
| Expected to be consigned to an Incineration Facility | 22.8 | 0.14 |
| Expected to be consigned to a Metal Treatment Facility | 44.2 | 1.4 |
| Expected to be consigned as Out of Scope | 0.57 | 1.4 |
| Expected to be recycled / reused | | |
| Disposal route not known | | |

Classification codes for waste expected to be consigned to a landfill facility: -

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

| Disposal Route | Stream volume % | | |
|--|-----------------|---------|---------|
| | 2022/23 | 2023/24 | 2024/25 |
| Expected to be consigned to the LLW Repository | 66.8 | 14.2 | 26.3 |
| Expected to be consigned to a Landfill Facility | | | |
| Expected to be consigned to an On-Site Disposal Facility | 16.4 | 37.5 | 2.4 |
| Expected to be consigned to an Incineration Facility | 12.0 | 13.0 | 24.1 |
| Expected to be consigned to a Metal Treatment Facility | 4.0 | 35.0 | 46.6 |
| Expected to be consigned as Out of Scope | 0.79 | 0.31 | 0.58 |
| Expected to be recycled / reused | | | |
| Disposal route not known | | | |

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Opportunities for alternative disposal routing: No

| Baseline Management Route | Opportunity Management Route | Stream volume (%) | Estimated Date that Opportunity will be realised | Opportunity Confidence | Comment |
|---------------------------|------------------------------|-------------------|--|------------------------|---------|
| - | - | - | - | - | - |

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 | 22.8 | 59.28 | 3 |
| 1/2 Height IP-2 Disposal/Re-usable ISO | 3.8 | 10 | 3 |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other (VLLW disposed on site - No packages) | 5.9 | | |

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 have been taken from the current WCH, but data on waste volumes and waste routes are based on the Waste Forecasting database as this information is more recent.

Waste consigned for disposal to LLWR in year of generation: 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: The activity has arisen as a result of PIE of experimental fuel. The waste has become contaminated during care and maintenance.

Uncertainty: The uncertainty associated with the fingerprinting analysis is likely to be 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 REM_TP_0116A and are based on the current WCH.

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| Nuclide | Mean radioactivity, TBq/m ³ | | | | Nuclide | Mean radioactivity, TBq/m ³ | | | |
|---------|--|----------------|-----------------|----------------|------------------|--|-----------------|-----------------|----------------|
| | Waste at 1.4.2022 | Bands and Code | Future arisings | Bands and Code | | Waste at 1.4.2022 | Bands and Code | Future arisings | Bands and Code |
| H 3 | | | 7.85E-07 | CC 2 | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | | | 2.11E-07 | CC 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 | | | 3.95E-08 | CC 2 | Pb 210 | | | | |
| Co 60 | | | 2.59E-06 | CC 2 | Bi 208 | | | | |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | | | 2.55E-05 | CC 2 | Po 210 | | | | |
| Zn 65 | | | | | Ra 223 | | | | |
| Se 79 | | | | | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | | | | |
| Kr 85 | | | | | Ra 228 | | | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | | | 6.05E-06 | CC 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 | | | | | U 232 | | | | |
| Ru 106 | | | | | U 233 | | | | |
| Pd 107 | | | | | U 234 | | | | |
| Ag 108m | | | | | U 235 | | | | |
| Ag 110m | | | | | U 236 | | | | |
| Cd 109 | | | | | U 238 | | | | |
| Cd 113m | | | | | Np 237 | | | | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | | 2.38E-07 | CC 2 | |
| Sn 123 | | | | | Pu 239 | | 7.25E-08 | CC 2 | |
| Sn 126 | | | | | Pu 240 | | 1.32E-07 | CC 2 | |
| Sb 125 | | | | | Pu 241 | | 3.10E-06 | CC 2 | |
| Sb 126 | | | | | Pu 242 | | | | |
| Te 125m | | | | | Am 241 | | 4.68E-07 | CC 2 | |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | | | Am 243 | | | | |
| Cs 134 | | | | | Cm 242 | | | | |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | | | 2.67E-05 | CC 2 | Cm 244 | | | | |
| 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 | | | 3.30E-08 | CC 2 | Total a | 0 | 9.10E-07 | CC 2 | |
| Eu 155 | | | | | Total b/g | 0 | 6.50E-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