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| WASTE STREAM | 5H305 | JET Decommissioning Concrete LLW |
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SITE Culham

SITE OWNER United Kingdom Atomic Energy Authority

WASTE CUSTODIAN United Kingdom Atomic Energy Authority

WASTE TYPE LLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

| | | Reported |
|------------------------|---------------------------|-----------------------|
| Stocks: | At 1.4.2022..... | 0 m ³ |
| Future arisings - | 1.4.2027 - 31.3.2029..... | 2798.5 m ³ |
| Total future arisings: | | 2798.5 m ³ |
| Total waste volume: | | 2798.5 m ³ |

Comment on volumes: This waste is from decommissioning so the annual arisings will vary with the plans and progress. These have yet to be developed as the JET facilities are still operational. The decommissioning programme is estimated to start in 2024 but the concrete wastes will not be produced until the demolition of the AGHS (Active Gas Handling System) and Torus Hall buildings around 2029.

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

WASTE SOURCE The waste arises from JET decommissioning activities.

PHYSICAL CHARACTERISTICS

General description: The waste comprises borated and plain concrete substantially associated with the Torus Hall shield walls floor and ceiling and from building structure (only plain concrete). All large blocks will be size reduced in order to be accommodated within LLW ISO containers.

Physical components (%wt): Concrete rubble (100%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~2

Comment on density: The waste contains concretes with solid densities of 2.66 t/m³ (plain) and 1.28 t/m³ (borated).

CHEMICAL COMPOSITION

General description and components (%wt): Plain concrete (98.3%), borated concrete (1.7%).

Chemical state: Alkali

Chemical form of radionuclides: H-3: Gas or oxide, chemically bound within concrete.

Metals and alloys (%wt): Possibility of small amounts of residual rebars.

| | (%wt) | Type(s) / Grade(s) with proportions | % of total C14 activity |
|---------------------------|-------|-------------------------------------|-------------------------|
| Stainless steel..... | 0 | | |
| Other ferrous metals..... | TR | | |
| Iron..... | TR | | |
| Aluminium..... | | | |
| Beryllium..... | TR | | |
| Cobalt..... | 0 | | |
| Copper..... | 0 | | |
| Lead..... | 0 | | |
| Magnox/Magnesium..... | 0 | | |

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Nickel..... 0
Titanium.....
Uranium..... 0
Zinc..... 0
Zircaloy/Zirconium..... 0
Other metals..... 0

Organics (%wt): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|-------------------------------------|-------|---------------------|-------------------------|
| Total cellulose..... | ~0 | | |
| Paper, cotton..... | ~0 | | |
| Wood..... | ~0 | | |
| 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..... | 0 | | |
| Oil or grease | 0 | | |
| Fuel..... | 0 | | |
| Asphalt/Tarmac (cont.coal tar)... | 0 | | |
| Asphalt/Tarmac (no coal tar).... | 0 | | |
| Bitumen..... | 0 | | |
| Others..... | 0 | | |
| Other organics..... | 0 | | |

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..... | 0 | | |
| Cementitious material..... | 100.0 | | |
| Sand..... | 0 | | |
| Glass/Ceramics..... | 0 | | |
| Graphite..... | 0 | | |
| Desiccants/Catalysts..... | 0 | | |
| Asbestos..... | 0 | | |
| Non/low friable..... | 0 | | |
| Moderately friable..... | 0 | | |

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|-------------------------------|----|
| Highly friable..... | 0 |
| Free aqueous liquids..... | 0 |
| Free non-aqueous liquids..... | 0 |
| Powder/Ash..... | NE |

Inorganic anions (%wt): -

| | (%wt) | Type(s) and comment |
|----------------|-------|---------------------|
| Fluoride..... | 0 | |
| Chloride..... | P | |
| Iodide..... | 0 | |
| Cyanide..... | 0 | |
| Carbonate..... | P | |
| Nitrate..... | 0 | |
| Nitrite..... | 0 | |
| Phosphate..... | P | |
| Sulphate..... | P | |
| 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..... | 0 | |
| Putrescible wastes..... | 0 | |
| Non-putrescible wastes..... | 0 | |
| Corrosive materials..... | 0 | |
| Pyrophoric materials..... | 0 | |
| Generating toxic gases..... | 0 | |
| Reacting with water..... | 0 | |
| 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 | |

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| Organometallics..... | 0 | |
| Phenol..... | 0 | |
| Styrene..... | 0 | |
| Tri-butyl phosphate..... | 0 | |
| Other organophosphates..... | 0 | |
| Vinyl chloride..... | 0 | |
| Arsenic..... | 0 | |
| Barium..... | P | |
| Boron..... | P | Present as bonated concrete (1.7% of stream). |
| Boron (in Boral)..... | 0 | |
| Boron (non-Boral)..... | P | |
| Cadmium..... | 0 | |
| Caesium..... | P | Potentially present in concrete as impurity. |
| Selenium..... | 0 | |
| Chromium..... | P | Present in concrete. |
| Molybdenum..... | 0 | |
| Thallium..... | | |
| Tin..... | 0 | |
| Vanadium..... | 0 | |
| Mercury compounds..... | | |
| Others..... | 0 | |
| Electronic Electrical Equipment (EEE) | | |
| EEE Type 1..... | 0 | |
| EEE Type 2..... | 0 | |
| EEE Type 3..... | 0 | |
| EEE Type 4..... | 0 | |
| EEE Type 5..... | 0 | |

Complexing agents (%wt): No

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

Potential for the waste to contain discrete items: No.

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) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None | | 100.0 |

Comment on planned treatments:

Treatment methods will depend on the exact nature of the waste which is not known at this stage.

Disposal Routes:

| Disposal Route | Stream volume % | Disposal density t/m3 |
|--|-----------------|-----------------------|
| Expected to be consigned to the LLW Repository | ~~15.0 | |
| Expected to be consigned to a Landfill Facility | ~~85.0 | |
| 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 | | |

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 | | | |
| 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 | | | |

Opportunities for alternative disposal routing: -

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

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 | ~~15.0 | <15.6 | 27 |

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: Expected to be <<10%.

Waste Characterisation Form (WCH): It is not yet determined if the waste meets LLWR's Waste Acceptance Criteria (WAC).

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 radioactivity arises from tritium contamination and there may be some low level neutron activation.

Uncertainty: The activity levels are 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: The specific activity is a conservative estimate based on the permitted activity concentrations of LLW and the volumes of waste produced.

Other information: -

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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 | | | 1.1E-04 | AC 2 | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | | | | | 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 | | | | | 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 | | | | |
| Sn 123 | | | | | Pu 239 | | | | |
| Sn 126 | | | | | Pu 240 | | | | |
| Sb 125 | | | | | Pu 241 | | | | |
| Sb 126 | | | | | Pu 242 | | | | |
| Te 125m | | | | | Am 241 | | | | |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | | | Am 243 | | | | |
| Cs 134 | | | | | Cm 242 | | | | |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | | | | | 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 | | | | | Total a | 0 | | 0 | |
| Eu 155 | | | | | Total b/g | 0 | | 1.1E-04 | AC 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