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| WASTE STREAM | 3J313 | Decommissioning Stage 3: Graphite ILW |
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SITE Dungeness B

SITE OWNER EDFE NGL

WASTE CUSTODIAN EDFE NGL

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

| | | Reported |
|------------------------|---------------------------|-----------------------|
| Stocks: | At 1.4.2022..... | 0 m ³ |
| Future arisings - | 1.4.2022 - 31.3.2108..... | 0 m ³ |
| | 1.4.2108 - 31.3.2109..... | 5.1 m ³ |
| | 1.4.2109 - 31.3.2110..... | 733.3 m ³ |
| | 1.4.2110 - 31.3.2111..... | 730.5 m ³ |
| | 1.4.2111 - 31.3.2112..... | 491.0 m ³ |
| Total future arisings: | | 1959.8 m ³ |
| Total waste volume: | | 1959.8 m ³ |

Comment on volumes: Waste volumes will be variable depending on station operating conditions. Volumes based on Back to Bio Shield strategy. Work is ongoing looking at optimising the strategy which could lead to a change in volume and timings of arisings across Final Site Clearance wastes (300s) and Pre C&M wastes (100s), in future submissions.

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

WASTE SOURCE Moderator and reflector graphite from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: Graphite blocks and other graphite components. Waste can be packaged in standard NDA packages.

Physical components (%vol): Graphite (~100%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.28

Comment on density: Future arisings based on envelope volume, density calculated on this basis.

CHEMICAL COMPOSITION

General description and components (%wt): Graphite and possible traces of ferrous metals.

Chemical state: -

Chemical form of radionuclides: H-3: Diffused into matrix
 C-14: Incorporated in the graphite
 Cl-36: Incorporated in the graphite
 Se-79: Not significant
 Tc-99: Not determined
 I-129: Not significant
 Ra: Radium content is insignificant
 Th: Thorium content is Insignificant
 U: Uranium content is insignificant
 Np: Neptunium content is insignificant
 Pu: Plutonium content is insignificant

Metals and alloys (%wt): -

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| | (%wt) | Type(s) / Grade(s) with proportions | % of total C14 activity |
|-------------------------------------|----------------|-------------------------------------|-------------------------|
| Stainless steel..... | NE | | |
| Other ferrous metals..... | NE | | |
| Iron..... | 0 | | |
| Aluminium..... | 0 | | |
| Beryllium..... | 0 | | |
| Cobalt..... | 0 | | |
| Copper..... | 0 | | |
| Lead..... | 0 | | |
| Magnox/Magnesium..... | 0 | | |
| Nickel..... | 0 | | |
| Titanium..... | 0 | | |
| Uranium..... | 0 | | |
| Zinc..... | 0 | | |
| Zircaloy/Zirconium..... | 0 | | |
| Other metals..... | 0 | | |
| Organics (%wt): | None expected. | | |
| | (%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 | | | |
| Fuel..... | | | |
| Asphalt/Tarmac (cont.coal tar)... | | | |
| Asphalt/Tarmac (no coal tar).... | | | |
| Bitumen..... | | | |
| Others..... | | | |
| Other organics..... | 0 | | |
| Other materials (%wt): | - | | |

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| | (%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..... | 0 | | |
| Sand..... | 0 | | |
| Glass/Ceramics..... | 0 | | |
| Graphite..... | 100.0 | | 100.0 |
| 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): None likely to be present.

| | (%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: No materials likely to pose a fire or other non-radiological hazard have been identified. Graphite presents a low fire risk; it is difficult but not impossible to ignite.

| | (%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 | |

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| | | |
|--|---|-----------------|
| Corrosive materials..... | 0 | |
| Pyrophoric materials..... | 0 | |
| Generating toxic gases..... | 0 | |
| Reacting with water..... | 0 | |
| Higher activity particles..... | P | May be present. |
| Soluble solids as bulk chemical compounds..... | 0 | |

Hazardous substances /
non hazardous pollutants: -

| | (%wt) | Type(s) and comment |
|---------------------------------------|-------|---------------------|
| Acrylamide..... | NE | |
| Benzene..... | NE | |
| Chlorinated solvents..... | NE | |
| Formaldehyde..... | NE | |
| Organometallics..... | NE | |
| Phenol..... | NE | |
| Styrene..... | NE | |
| Tri-butyl phosphate..... | NE | |
| Other organophosphates..... | NE | |
| Vinyl chloride..... | NE | |
| Arsenic..... | NE | |
| Barium..... | NE | |
| Boron..... | NE | |
| Boron (in Boral)..... | NE | |
| Boron (non-Boral)..... | NE | |
| Cadmium..... | NE | |
| Caesium..... | NE | |
| Selenium..... | NE | |
| Chromium..... | NE | |
| Molybdenum..... | NE | |
| Thallium..... | NE | |
| Tin..... | NE | |
| Vanadium..... | NE | |
| Mercury compounds..... | NE | |
| Others..... | NE | |
| Electronic Electrical Equipment (EEE) | | |
| EEE Type 1..... | 0 | |
| EEE Type 2..... | 0 | |
| EEE Type 3..... | 0 | |
| EEE Type 4..... | 0 | |
| EEE Type 5..... | 0 | |

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Complexing agents (%wt): Not yet determined

| | (%wt) | Type(s) and comment |
|--------------------------------|-------|--------------------------------|
| EDTA..... | NE | |
| DPTA..... | NE | |
| NTA..... | NE | |
| Polycarboxylic acids..... | NE | |
| Other organic complexants..... | NE | Only trace quantities, if any. |
| Total complexing agents..... | NE | |

Potential for the waste to contain discrete items: No.

PACKAGING AND CONDITIONING

Conditioning method: The waste is not expected to be supercompacted. It will be placed in "baskets" in the waste packages, and is assumed to be encapsulated.

Plant Name: -

Location: -

Plant startup date: 85 years after reactor shut-down.

Total capacity (m³/y incoming waste): ~5000.0

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): -

Other information: Waste will be conditioned when removed from the reactor.

| Likely container type: | Container | Waste packaged (%vol) | Waste loading (m ³) | Payload (m ³) | Number of packages |
|------------------------|-----------------------------------|-----------------------|---------------------------------|---------------------------|--------------------|
| | 4m box (100mm concrete shielding) | 100.0 | ~10.67 | 14.3 | 184 |

Likely container type comment: -

Range in container waste volume: -

Other information on containers: Stainless Steel.

Likely conditioning matrix: BFS/OPC

Other information: -

Conditioned density (t/m³): ~1.86

Conditioned density comment: Assumes waste will be encapsulated, matrix would be likely to be BFS/OPC.

Other information on conditioning: The waste will be in baskets placed in the waste packages. Baskets of different Stage 3 ILW wastes may be in the same waste package.

Opportunities for alternative disposal routing: Not yet determined

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

RADIOACTIVITY

| | |
|---|---|
| Source: | Activation of the graphite and impurities, Contamination by other activated materials. |
| Uncertainty: | The values quoted were derived by calculation from available material specification and are indicative of the activities that are expected. The major source of uncertainty is the impurity levels. |
| 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: | Activation/decay calculations based on neutron flux and projected operating history. |
| Other information: | There may be some contamination by Cs137. The activities quoted are for the time at which this waste will arise (i.e. ~85 years after end of generation). |

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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 | | | 1.07E-03 | CC 2 | Gd 153 | | | | |
| Be 10 | | | | 8 | Ho 163 | | | | |
| C 14 | | | 1.3E-01 | CC 2 | Ho 166m | | 4E-07 | CC 2 | |
| Na 22 | | | | 4 | Tm 170 | | | | |
| Al 26 | | | | 4 | Tm 171 | | | | |
| Cl 36 | | | 7.58E-04 | CC 2 | Lu 174 | | | | |
| Ar 39 | | | | | Lu 176 | | | | |
| Ar 42 | | | | | Hf 178n | | | | |
| K 40 | | | | | Hf 182 | | | | |
| Ca 41 | | | 1.41E-05 | CC 2 | Pt 193 | | | | |
| Mn 53 | | | | | Tl 204 | | | | |
| Mn 54 | | | | 8 | Pb 205 | | | | |
| Fe 55 | | | | 8 | Pb 210 | | | | 8 |
| Co 60 | | | 1.92E-07 | CC 2 | Bi 208 | | | | |
| Ni 59 | | | 8.69E-06 | CC 2 | Bi 210m | | | | |
| Ni 63 | | | 5.55E-04 | CC 2 | Po 210 | | | | 8 |
| Zn 65 | | | | 8 | Ra 223 | | | | |
| Se 79 | | | | 8 | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | | | | 8 |
| Kr 85 | | | | | Ra 228 | | | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | | | | 8 | Th 227 | | | | |
| Zr 93 | | | | 8 | Th 228 | | | | |
| Nb 91 | | | | | Th 229 | | | | 8 |
| Nb 92 | | | | | Th 230 | | | | 8 |
| Nb 93m | | | 3.47E-08 | CC 2 | Th 232 | | | | 8 |
| Nb 94 | | | 4.94E-08 | CC 2 | Th 234 | | | | |
| Mo 93 | | | 6.25E-06 | CC 2 | Pa 231 | | | | 8 |
| Tc 97 | | | | | Pa 233 | | | | |
| Tc 99 | | | 1.23E-06 | CC 2 | U 232 | | | | |
| Ru 106 | | | | 8 | U 233 | | | | 8 |
| Pd 107 | | | | 8 | U 234 | | | | 8 |
| Ag 108m | | | 4.2E-07 | CC 2 | U 235 | | | | 8 |
| Ag 110m | | | | | U 236 | | | | 8 |
| Cd 109 | | | | | U 238 | | | | 8 |
| Cd 113m | | | | | Np 237 | | | | 8 |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | 8.66E-07 | CC 2 | Pu 238 | | | | 8 |
| Sn 123 | | | | | Pu 239 | | | | 8 |
| Sn 126 | | | | 8 | Pu 240 | | | | 8 |
| Sb 125 | | | | | Pu 241 | | | | 8 |
| Sb 126 | | | | | Pu 242 | | | | 8 |
| Te 125m | | | | | Am 241 | | | | 8 |
| Te 127m | | | | | Am 242m | | | | 8 |
| I 129 | | | | 8 | Am 243 | | | | 8 |
| Cs 134 | | | | 8 | Cm 242 | | | | 8 |
| Cs 135 | | | | 8 | Cm 243 | | | | 8 |
| Cs 137 | | | | 8 | Cm 244 | | | | 8 |
| Ba 133 | | | 1.38E-08 | CC 2 | Cm 245 | | | | 8 |
| La 137 | | | | | Cm 246 | | | | 8 |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | | | | 8 | Cf 249 | | | | |
| Pm 145 | | | 3.3E-08 | CC 2 | Cf 250 | | | | |
| Pm 147 | | | | 8 | Cf 251 | | | | |
| Sm 147 | | | | | Cf 252 | | | | |
| Sm 151 | | | 3.41E-07 | CC 2 | Other a | | | | 8 |
| Eu 152 | | | 2.85E-08 | CC 2 | Other b/g | | | | 8 |
| Eu 154 | | | 7.72E-07 | CC 2 | Total a | 0 | <1E-09 | | 8 |
| Eu 155 | | | | 6 | Total b/g | 0 | 1.32E-01 | 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