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| WASTE STREAM | 2D45 | Magnox Fuel End Crops |
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SITE Sellafield
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Sellafield Limited
WASTE TYPE ILW

WASTE VOLUMES

| | | |
|------------------------|------------------|---------------------|
| | | Reported |
| Stocks: | At 1.4.2019..... | 27.4 m ³ |
| Total future arisings: | | 0 m ³ |
| Total waste volume: | | 27.4 m ³ |

Comment on volumes: End-cropping of Tokai Mura fuel in FHP has now been completed. No further arisings are expected. TMECS will be removed from the pond in 2035. Volume known precisely as it is a static stock, but some uncertainty present due to unknown carry of inventory from end cropping process.

| | | | | |
|---------------------------------|----------------|--------|------------------|---|
| Uncertainty factors on volumes: | Stock (upper): | x 1.05 | Arisings (upper) | x |
| | Stock (lower): | x 0.95 | Arisings (lower) | x |

WASTE SOURCE End crops from Magnox fuel elements.

PHYSICAL CHARACTERISTICS

General description: End crops comprise a cylinder (~50 x 50mm) composed of uranium and Magnox and containing a small disc of sintered alumina and a small zirconium plug. There are no large items present. The waste has not undergone any change since it was generated.

Physical components (%wt): Uranium annuli (60 wt%), Magnox cladding and end fittings (25 wt%), sintox (alumina) discs (7 wt%), zirconium plugs (8 wt%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 1.54

Comment on density: -

CHEMICAL COMPOSITION

General description and components (%wt): Magnox (25%), uranium (60%), zirconium (8%) and alumina (7%).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Present in elemental and reacted forms.
C-14: Present in elemental and reacted forms.
Cl-36: Unknown.
Se-79: Present in elemental and reacted forms.
Tc-99: Present in elemental and reacted forms.
I-129: Unknown.
Ra: Ra isotopes will exist in the metallic and oxide fuel.
U: Present in metallic and reacted forms (oxides and hydrides).
Np: Present in metallic and reacted forms.
Pu: Present in metallic and reacted forms.

Metals and alloys (%wt): No sheet metal. Bulk metal in the form of cylinders 50mm x 50mm.

| | |
|---------------------------|------|
| Stainless steel..... | 0 |
| Other ferrous metals..... | 0 |
| Iron..... | 0 |
| Aluminium..... | 0 |
| Beryllium..... | 0 |
| Cobalt..... | 0 |
| Copper..... | 0 |
| Lead..... | 0 |
| Magnox/Magnesium..... | 25.0 |

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| | Nickel..... | 0 |
| | Titanium..... | 0 |
| | Uranium..... | 60.0 |
| | Zinc..... | 0 |
| | Zircaloy/Zirconium..... | 8.0 |
| | Other metals..... | 0 |
| Organics (%wt): | No organic materials are present. None present. | |
| | 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): | - | |
| | Inorganic ion exchange materials. | 0 |
| | Inorganic sludges and flocs..... | 0 |
| | Soil..... | 0 |
| | Brick/Stone/Rubble..... | 0 |
| | Cementitious material..... | 0 |
| | Sand..... | 0 |
| | Glass/Ceramics..... | 7.0 |
| | 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 |

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Inorganic anions (%wt):

No inorganic anions are present.

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

The waste contains Magnox and uranium hydride.

| | |
|--|------|
| Combustible metals..... | 25.0 |
| 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..... | 25.0 |
| Active particles..... | 0 |
| Soluble solids as bulk chemical compounds..... | 0 |

Hazardous substances / non hazardous pollutants:

-

| | |
|-----------------------------|---|
| 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 |

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Boron..... 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.....
 EEE Type 2.....
 EEE Type 3.....
 EEE Type 4.....
 EEE Type 5.....

Complexing agents (%wt): No
 EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents.....

PACKAGING AND CONDITIONING

Conditioning method: To be determined.
 Plant Name: Bulk Uranics Fuel Treatment (BUFT) capability.
 Location: Sellafield.
 Plant startup date: 2032
 Total capacity (m³/y incoming waste): -
 Target start date for packaging this stream: 2037
 Throughput for this stream (m³/y incoming waste): -
 Other information: BUFT is a notional capability at this stage rather than a defined facility.

| | | | | | |
|------------------------|---|-----------------------|---------------------------------|---------------------------|--------------------|
| Likely container type: | Container | Waste packaged (%vol) | Waste loading (m ³) | Payload (m ³) | Number of packages |
| | Sellafield enhanced 3m ³ box | 100.0 | NE | 2.15 | NE |

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Likely container type comment: -

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix:
Other information: -

Conditioned density (t/m³): NE

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: No

| Treatment | Stream volume (%) | Comment |
|-----------|-------------------|---------|
| - | - | - |

RADIOACTIVITY

Source: Fission products and actinides.

Uncertainty: The activity is calculated and is estimated to be within a factor of 50%.

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: -

Other information: The specific activities are at the time of arising. "Other alpha" is U-235m.

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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 | 3.60E-01 | AA 2 | | | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | 1.05E-03 | AA 2 | | | Ho 166m | | | | |
| Na 22 | | | | | Tm 170 | | | | |
| Al 26 | | | | | Tm 171 | | | | |
| Cl 36 | 1.41E-03 | BB 2 | | | Lu 174 | | | | |
| Ar 39 | | | | | Lu 176 | | | | |
| Ar 42 | | | | | Hf 178n | | | | |
| K 40 | | | | | Hf 182 | | | | |
| Ca 41 | 2.47E-03 | AA 2 | | | Pt 193 | | | | |
| Mn 53 | | | | | Tl 204 | | | | |
| Mn 54 | 2.25E-09 | AA 2 | | | Pb 205 | | | | |
| Fe 55 | 4.92E-03 | AA 2 | | | Pb 210 | 4.76E-09 | AA 2 | | |
| Co 60 | 2.68E-01 | AA 2 | | | Bi 208 | | | | |
| Ni 59 | 1.06E-04 | AA 2 | | | Bi 210m | | | | |
| Ni 63 | 1.16E-02 | AA 2 | | | Po 210 | 4.53E-09 | AA 2 | | |
| Zn 65 | 1.40E-09 | AA 2 | | | Ra 223 | 1.04E-07 | AA 2 | | |
| Se 79 | | | | | Ra 225 | 4.28E-11 | AA 2 | | |
| Kr 81 | | | | | Ra 226 | 1.94E-08 | AA 2 | | |
| Kr 85 | 5.75E+00 | AA 2 | | | Ra 228 | 8.45E-13 | AA 2 | | |
| Rb 87 | | | | | Ac 227 | 1.05E-07 | AA 2 | | |
| Sr 90 | 1.44E+02 | AA 2 | | | Th 227 | 1.03E-07 | AA 2 | | |
| Zr 93 | 7.75E-03 | AA 2 | | | Th 228 | 7.18E-13 | AA 2 | | |
| Nb 91 | | | | | Th 229 | 4.30E-11 | AA 2 | | |
| Nb 92 | | | | | Th 230 | 2.97E-06 | AA 2 | | |
| Nb 93m | 5.06E-03 | AA 2 | | | Th 232 | 1.24E-12 | AA 2 | | |
| Nb 94 | 1.47E-09 | AA 2 | | | Th 234 | 1.13E-02 | AA 2 | | |
| Mo 93 | | | | | Pa 231 | 2.65E-07 | AA 2 | | |
| Tc 97 | | | | | Pa 233 | 3.69E-04 | AA 2 | | |
| Tc 99 | 5.43E-02 | AA 2 | | | U 232 | | | | |
| Ru 106 | 2.28E-04 | AA 2 | | | U 233 | 3.74E-08 | AA 2 | | |
| Pd 107 | | | | | U 234 | 1.02E-02 | AA 2 | | |
| Ag 108m | | | | | U 235 | 3.17E-04 | AA 2 | | |
| Ag 110m | 1.75E-09 | AA 2 | | | U 236 | 1.01E-03 | AA 2 | | |
| Cd 109 | | | | | U 238 | 1.13E-02 | AA 2 | | |
| Cd 113m | | | | | Np 237 | 3.70E-04 | AA 2 | | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | 1.53E-03 | AA 2 | | | Pu 238 | 8.96E-01 | AA 2 | | |
| Sn 123 | 2.87E-16 | AA 2 | | | Pu 239 | 3.68E+00 | AA 2 | | |
| Sn 126 | | | | | Pu 240 | 3.44E+00 | AA 2 | | |
| Sb 125 | 3.18E-02 | AA 2 | | | Pu 241 | 7.46E+01 | AA 2 | | |
| Sb 126 | | | | | Pu 242 | 1.23E-03 | AA 2 | | |
| Te 125m | 7.98E-03 | AA 2 | | | Am 241 | 6.89E+00 | AA 2 | | |
| Te 127m | 2.62E-20 | AA 2 | | | Am 242m | 1.04E-02 | AA 2 | | |
| I 129 | 9.68E-05 | AA 2 | | | Am 243 | 2.10E-03 | AA 2 | | |
| Cs 134 | 1.61E-02 | AA 2 | | | Cm 242 | 8.56E-03 | AA 2 | | |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | 1.97E+02 | AA 2 | | | Cm 244 | 1.30E-02 | AA 2 | | |
| Ba 133 | | | | | Cm 245 | 5.19E-07 | AA 2 | | |
| La 137 | | | | | Cm 246 | | | | |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | 1.94E-05 | AA 2 | | | Cf 249 | | | | |
| Pm 145 | | | | | Cf 250 | | | | |
| Pm 147 | 8.35E-01 | AA 2 | | | Cf 251 | | | | |
| Sm 147 | 1.26E-08 | AA 2 | | | Cf 252 | | | | |
| Sm 151 | 1.13E+00 | AA 2 | | | Other a | 3.67E+00 | AA 2 | | |
| Eu 152 | 2.51E-02 | AA 2 | | | Other b/g | 5.37E+01 | AA 2 | | |
| Eu 154 | 7.94E-01 | AA 2 | | | Total a | 1.86E+01 | AA 2 | 0 | |
| Eu 155 | 3.72E-01 | AA 2 | | | Total b/g | 4.79E+02 | AA 2 | 0 | |

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