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| WASTE STREAM | 2D33 | Fuel Handling Plant Sludges |
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SITE Sellafield
SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

| | | |
|------------------------|------------------|----------------------|
| | | Reported |
| Stocks: | At 1.4.2022..... | ~33.0 m ³ |
| Total future arisings: | | 0 m ³ |
| Total waste volume: | | 33.0 m ³ |

Comment on volumes: Based on estimated receipts of Uranium Bit Bins (UBBs). Note, nearly all UBB skips have been imported into FHP. As UBBs have been generated these are referred to as stocks for the purpose of the UKRWI (i.e. no sludge arisings from new sources are foreseen). It is approximated that where sludge is present, the skip holds 50% fuel and 50% sludge, giving 0.5m³ sludge per skip. However the sludge volume could vary from very little to the majority of the skip contents. A total of 66 consolidated UBB skips is foreseen as the upper bound.

| | | | | |
|---------------------------------|----------------|-------|------------------|---|
| Uncertainty factors on volumes: | Stock (upper): | x 2.0 | Arisings (upper) | x |
| | Stock (lower): | x 0.1 | Arisings (lower) | x |

WASTE SOURCE Importing of Magnox Uranium Bit Bin skips with sludge.

PHYSICAL CHARACTERISTICS

General description: Magnox sludge from fuel handling plant consisting of a slurry of fine particles and some larger particles. No special handling requirements.
 Physical components (%wt): Magnox sludge (100%).
 Sealed sources: The waste does not contain sealed sources.
 Bulk density (t/m³): 0.6
 Comment on density: The density is an estimated typical raw sludge density.

CHEMICAL COMPOSITION

General description and components (%wt): Magnox sludge (100%).
 Chemical state: Alkali
 Chemical form of radionuclides: U: U234, U235, U236, U238. Present as metal and oxides.
 Pu: Pu238, Pu239, Pu240, Pu241, Pu242. Present as metal and oxide.
 Metals and alloys (%wt): -

| | (%wt) | Type(s) / Grade(s) with proportions | % of total C14 activity |
|---------------------------|-------|-------------------------------------|-------------------------|
| Stainless steel..... | 0 | | |
| Other ferrous metals..... | 0 | | |
| Iron..... | 0 | | |
| Aluminium..... | 0 | | |
| Beryllium..... | 0 | | |
| Cobalt..... | 0 | | |
| Copper..... | 0 | | |
| Lead..... | 0 | | |
| Magnox/Magnesium..... | <5.0 | | |
| Nickel..... | 0 | | |

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Titanium..... 0
 Uranium..... 5.0
 Zinc..... 0
 Zircaloy/Zirconium..... 0
 Other metals..... 0

Organics (%wt): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|-------------------------------------|-------|---------------------|-------------------------|
| Total cellulosics..... | 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..... | 90.0 | | |
| Soil..... | 0 | | |
| Brick/Stone/Rubble..... | 0 | | |
| Cementitious material..... | 0 | | |
| Sand..... | 0 | | |
| Glass/Ceramics..... | 0 | | |
| Graphite..... | 0 | | |
| Desiccants/Catalysts..... | 0 | | |
| Asbestos..... | 0 | | |
| Non/low friable..... | 0 | | |
| Moderately friable..... | 0 | | |
| Highly friable..... | 0 | | |

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|-------------------------------|---|
| Free aqueous liquids..... | 0 |
| Free non-aqueous liquids..... | 0 |
| Powder/Ash..... | 0 |

Inorganic anions (%wt): Hydroxide is present as magnesium hydroxide. Carbonates are present. Others are unlikely to be present except in trace quantities.

| | (%wt) | Type(s) and comment |
|----------------|-------|---------------------|
| Fluoride..... | TR | |
| Chloride..... | TR | |
| Iodide..... | TR | |
| Cyanide..... | NE | |
| Carbonate..... | P | |
| Nitrate..... | TR | |
| Nitrite..... | TR | |
| Phosphate..... | TR | |
| Sulphate..... | TR | |
| Sulphide..... | TR | |

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..... | |
| 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..... | 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..... | | |
| DPTA..... | | |
| NTA..... | | |
| Polycarboxylic acids..... | | |
| Other organic complexants..... | | |
| Total complexing agents..... | 0 | |

Potential for the waste to contain discrete items: Not yet determined. The waste itself is not judged to be a Discrete Item but may need to be revised depending on the treatment, conditioning, and packaging of the waste.

PACKAGING AND CONDITIONING

Conditioning method: Conditioning plans are yet to be established, the sludge is likely to be routed to SIXEP and SWP for treatment. Any fuel based sludge is likely to be routed to BEP or BUFT.

Plant Name: SIXEP, BEP, BUFT

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Location: Sellafield
 Plant startup date: -
 Total capacity (m³/y incoming waste): -
 Target start date for packaging this stream: -
 Throughput for this stream (m³/y incoming waste): -
 Other information: -

| | | | | | |
|------------------------|--------------------------------|-----------------------|---------------------------------|---------------------------|--------------------|
| Likely container type: | Container | Waste packaged (%vol) | Waste loading (m ³) | Payload (m ³) | Number of packages |
| | Sellafield 3m ³ box | 100.0 | ~0.8 | 2.7 | 42 |

Likely container type comment: -
 Range in container waste volume: -
 Other information on containers: Stainless Steel
 Likely conditioning matrix: Not specified
 Other information: -
 Conditioned density (t/m³): NE
 Conditioned density comment: -
 Other information on conditioning: -
 Opportunities for alternative disposal routing: No

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

RADIOACTIVITY

Source: Magnox sludge containing uranium and mixed fission 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: Major radionuclides are measured by analysis of samples (1996) taken from storage tanks.
 Other information: -

WASTE STREAM

2D33

Fuel Handling Plant Sludges

| 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 | | | | | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | | | | | Ho 166m | | | | |
| Na 22 | | | | | Tm 170 | | | | |
| Al 26 | | | | | Tm 171 | | | | |
| Cl 36 | 1.20E-04 | BB 2 | | | 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 | 4.32E-11 | BB 1 | | |
| Co 60 | 9.89E-03 | BB 1 | | | Bi 208 | | | | |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | | | | | Po 210 | 4.14E-11 | BB 1 | | |
| Zn 65 | | | | | Ra 223 | 1.23E-09 | BB 1 | | |
| Se 79 | 3.57E-05 | BB 2 | | | Ra 225 | 1.87E-12 | BB 2 | | |
| Kr 81 | | | | | Ra 226 | 1.62E-10 | BB 1 | | |
| Kr 85 | | | | | Ra 228 | 3.16E-14 | BB 1 | | |
| Rb 87 | | | | | Ac 227 | 1.25E-09 | BB 1 | | |
| Sr 90 | 2.78E+01 | BB 1 | | | Th 227 | 1.22E-09 | BB 1 | | |
| Zr 93 | 1.30E-03 | BB 2 | | | Th 228 | 2.46E-14 | BB 1 | | |
| Nb 91 | | | | | Th 229 | 1.89E-12 | BB 2 | | |
| Nb 92 | | | | | Th 230 | 3.94E-08 | BB 1 | | |
| Nb 93m | 2.81E-04 | BB 2 | | | Th 232 | 5.98E-14 | BB 1 | | |
| Nb 94 | | | | | Th 234 | 1.52E-03 | BB 1 | | |
| Mo 93 | | | | | Pa 231 | 5.64E-09 | BB 1 | | |
| Tc 97 | | | | | Pa 233 | 7.68E-05 | BB 2 | | |
| Tc 99 | 7.42E-03 | BB 1 | | | U 232 | | | | |
| Ru 106 | 1.93E-03 | BB 2 | | | U 233 | 2.39E-09 | BB 2 | | |
| Pd 107 | | | | | U 234 | 6.05E-04 | BB 1 | | |
| Ag 108m | | | | | U 235 | 3.77E-05 | BB 1 | | |
| Ag 110m | | | | | U 236 | 1.76E-04 | BB 1 | | |
| Cd 109 | | | | | U 238 | 1.56E-03 | BB 1 | | |
| Cd 113m | | | | | Np 237 | 7.88E-05 | BB 2 | | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | 3.91E-01 | BB 1 | | |
| Sn 123 | | | | | Pu 239 | 5.86E-01 | BB 1 | | |
| Sn 126 | | | | | Pu 240 | 7.68E-01 | BB 1 | | |
| Sb 125 | | | | | Pu 241 | 2.59E+01 | BB 1 | | |
| Sb 126 | | | | | Pu 242 | 6.84E-04 | BB 1 | | |
| Te 125m | | | | | Am 241 | 1.68E+00 | BB 1 | | |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | 2.01E-05 | BB 2 | | | Am 243 | | | | |
| Cs 134 | 3.94E-02 | BB 1 | | | Cm 242 | | | | |
| Cs 135 | 1.18E-04 | BB 2 | | | Cm 243 | | | | |
| Cs 137 | 5.76E+00 | BB 1 | | | Cm 244 | | | | |
| Ba 133 | | | | | Cm 245 | | | | |
| La 137 | | | | | Cm 246 | | | | |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | 1.48E-04 | BB 2 | | | 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 | 2.64E-01 | BB 1 | | | Total a | 3.43E+00 | BB 2 | 0 | |
| Eu 155 | 1.26E-01 | BB 1 | | | Total b/g | 5.99E+01 | BB 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