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| WASTE STREAM | 2F27 | AGR Pond Sludge |
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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..... | ~6.6 m ³ |
| Future arisings - | 1.4.2019 - 31.3.2042..... | 4.1 m ³ |
| Total future arisings: | | 4.1 m ³ |
| Total waste volume: | | 10.7 m ³ |

Comment on volumes: Arising is estimated at 0.18m³ per year. Volumes are after centrifuging of sludge.

Upper and lower uncertainties on masses are both a factor of 1.5.

Uncertainty factors on volumes:

| | | | |
|----------------|--------|------------------|--------|
| Stock (upper): | x 1.5 | Arisings (upper) | x 1.5 |
| Stock (lower): | x 0.67 | Arisings (lower) | x 0.67 |

WASTE SOURCE The waste contains wind blown debris, algae (both alive and dead), guano, feathers and some objects inadvertently dropped in the pond.

PHYSICAL CHARACTERISTICS

General description: Suspended solids. There are not expected to be any large items.
 Physical components (%wt): Constituents of centrifuged solids are algae (66%) and guano/sludge (34%).
 Sealed sources: The waste does not contain sealed sources.
 Bulk density (t/m³): 1.61
 Comment on density: Density after centrifuging.

CHEMICAL COMPOSITION

General description and components (%wt): Chemical constituents are those present in dust, algae and guano etc. The waste includes sodium, manganese, carbon, nitrogen, iron, silicon, aluminium, sulphur, chlorine, phosphorus, potassium, tin, zinc, lead, copper, nickel.

Chemical state: Alkali

Chemical form of radionuclides: -

Metals and alloys (%wt): Metal only present as dispersed fines; no sheet or bulk metal.

- Stainless steel..... P
- Other ferrous metals..... P
- Iron.....
- Aluminium..... P
- Beryllium.....
- Cobalt..... 0
- Copper..... TR
- Lead..... TR
- Magnox/Magnesium..... TR
- Nickel.....
- Titanium.....
- Uranium.....
- Zinc..... TR
- Zircaloy/Zirconium..... 0

WASTE STREAM**2F27****AGR Pond Sludge**

| | | |
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| | Other metals..... | 0 |
| Organics (%wt): | Cellulose only present in trace amounts from paper dropped into the pond. Perspex used in pond; some may be present. Rubber may be present. Neoprene 'O' rings possibly. | |
| | Total cellulosics..... | TR |
| | Paper, cotton..... | |
| | Wood..... | |
| | Halogenated plastics | 0 |
| | Total non-halogenated plastics..... | TR |
| | Condensation polymers..... | 0 |
| | Others..... | TR |
| | Organic ion exchange materials.... | 0 |
| | Total rubber..... | TR |
| | Halogenated rubber | TR |
| | Non-halogenated rubber..... | TR |
| | Hydrocarbons..... | |
| | Oil or grease | |
| | Fuel..... | |
| | Asphalt/Tarmac (cont.coal tar)... | |
| | Asphalt/Tarmac (no coal tar).... | |
| | Bitumen..... | |
| | Others..... | |
| | Other organics..... | TR |
| Other materials (%wt): | Wind blown sand dispersed throughout the sludge | |
| | Inorganic ion exchange materials. | 0 |
| | Inorganic sludges and flocs..... | P |
| | Soil..... | P |
| | Brick/Stone/Rubble..... | TR |
| | Cementitious material..... | 0 |
| | Sand..... | |
| | Glass/Ceramics..... | |
| | Graphite..... | 0 |
| | Desiccants/Catalysts..... | |
| | Asbestos..... | 0 |
| | Non/low friable..... | |
| | Moderately friable..... | |
| | Highly friable..... | |
| | Free aqueous liquids..... | 0 |
| | Free non-aqueous liquids..... | 0 |
| | Powder/Ash..... | 0 |
| Inorganic anions (%wt): | Carbonates and nitrates are present. Chlorides, sulphates and sulphides are present as minor constituents. Phosphates are present in trace amounts. | |

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| Fluoride..... | 0 |
| Chloride..... | P |
| Iodide..... | 0 |
| Cyanide..... | 0 |
| Carbonate..... | P |
| Nitrate..... | P |
| Nitrite..... | NE |
| Phosphate..... | TR |
| Sulphate..... | P |
| Sulphide..... | P |

Materials of interest for waste acceptance criteria:

Waste is largely algae.

| | |
|--|-------|
| Combustible metals..... | 0 |
| Low flash point liquids..... | 0 |
| Explosive materials..... | 0 |
| Phosphorus..... | 0 |
| Hydrides..... | 0 |
| Biological etc. materials..... | >66.0 |
| Biodegradable materials..... | 0 |
| Putrescible wastes..... | 0 |
| Non-putrescible wastes..... | |
| Corrosive materials..... | 0 |
| Pyrophoric materials..... | 0 |
| Generating toxic gases..... | 0 |
| Reacting with water..... | 0 |
| Active particles..... | |
| Soluble solids as bulk chemical compounds..... | |

Algae (66%); guano.

Hazardous substances / non hazardous pollutants:

Hydrocarbons are present in algae. Sulphur, lead, copper, nickel and possibly boron may be present in trace amounts.

| | |
|-----------------------------|--|
| Acrylamide..... | |
| Benzene..... | |
| Chlorinated solvents..... | |
| Formaldehyde..... | |
| Organometallics..... | |
| Phenol..... | |
| Styrene..... | |
| Tri-butyl phosphate..... | |
| Other organophosphates..... | |
| Vinyl chloride..... | |
| Arsenic..... | |
| Barium..... | |
| Boron..... | |

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Cadmium.....
 Caesium.....
 Selenium.....
 Chromium.....
 Molybdenum.....
 Thallium.....
 Tin.....
 Vanadium.....
 Mercury compounds.....
 Others.....
 Electronic Electrical Equipment (EEE)
 EEE Type 1.....
 EEE Type 2.....
 EEE Type 3.....
 EEE Type 4.....
 EEE Type 5.....

Complexing agents (%wt):

EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....

 Total complexing agents..... 0

No complexing agents are present.

PACKAGING AND CONDITIONING

Conditioning method: Strategy under development.
 Plant Name: Not yet established.
 Location: Sellafield.
 Plant startup date: Not yet established.
 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 |
|---------------|-----------------------|---------------------------------|---------------------------|--------------------|
| Not specified | 100.0 | NE | NE | 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:

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

RADIOACTIVITY

Source: The main sources are Co-60, Cs-137, Cs-134, Mn-54 and Co-58.

Uncertainty: Accuracy of activity is within a factor of 10.

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: Activities are after centrifuging to remove water. Other alpha and other beta/gamma not yet determined.

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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 | | | | | 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 | <1.60E-06 | D 1 | <4.74E-05 | 3 | Pb 205 | | | | |
| Fe 55 | 1.42E-03 | C D 1 | 1.06E-02 | C D 2 | Pb 210 | | | | |
| Co 60 | 1.13E-03 | C D 1 | 3.72E-03 | C D 2 | Bi 208 | | | | |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | 6.97E-03 | C D 1 | 7.47E-03 | C D 2 | Po 210 | | | | |
| Zn 65 | <3.64E-06 | D 1 | <1.38E-04 | 3 | Ra 223 | | | | |
| Se 79 | | | | | Ra 225 | | | | |
| Kr 81 | | | | | Ra 226 | | | | |
| Kr 85 | | | | | Ra 228 | | | | |
| Rb 87 | | | | | Ac 227 | | | | |
| Sr 90 | 5.85E-05 | C D 1 | 7.40E-05 | C D 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 | <2.01E-05 | D 1 | <5.03E-04 | 3 | U 233 | | | | |
| Pd 107 | | | | | U 234 | | | | |
| Ag 108m | | | | | U 235 | | | | |
| Ag 110m | | | | | U 236 | | | | |
| Cd 109 | | | | | U 238 | | | | |
| Cd 113m | | | | | Np 237 | <2.45E-04 | D 1 | <2.45E-04 | 3 |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | | | | |
| Sn 123 | | | | | Pu 239 | | | | |
| Sn 126 | | | | | Pu 240 | | | | |
| Sb 125 | <2.20E-05 | D 1 | <1.62E-04 | 3 | Pu 241 | | | | |
| Sb 126 | | | | | Pu 242 | | | | |
| Te 125m | | | | | Am 241 | <9.16E-05 | D 1 | <9.31E-05 | 3 |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | | | Am 243 | | | | |
| Cs 134 | <2.22E-05 | D 1 | <2.41E-04 | 3 | Cm 242 | | | | |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | 8.04E-03 | C D 1 | 1.01E-02 | C D 2 | Cm 244 | | | | |
| Ba 133 | | | | | Cm 245 | | | | |
| La 137 | | | | | Cm 246 | | | | |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | <4.59E-06 | D 1 | <1.49E-04 | 3 | Cf 249 | | | | |
| Pm 145 | | | | | Cf 250 | | | | |
| Pm 147 | | | | | Cf 251 | | | | |
| Sm 147 | | | | | Cf 252 | | | | |
| Sm 151 | | | | | Other a | 5.82E-04 | C D 1 | 5.82E-04 | C D 2 |
| Eu 152 | | | | | Other b/g | | | | |
| Eu 154 | <4.99E-05 | D 1 | <1.07E-04 | 3 | Total a | <9.19E-04 | D 1 | <9.20E-04 | 3 |
| Eu 155 | <2.31E-05 | D 1 | <8.17E-05 | 3 | Total b/g | <1.78E-02 | D 1 | <3.34E-02 | 3 |

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