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|---------------------|-------------|---|
| WASTE STREAM | 9A66 | Miscellaneous Contaminated Items from Post Irradiation Examination |
|---------------------|-------------|---|

SITE Berkeley
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW

WASTE VOLUMES

| | | |
|---------------------------------|--|--------------------|
| | | Reported |
| Stocks: | At 1.4.2019..... | 0.1 m ³ |
| Total future arisings: | | 0 m ³ |
| Total waste volume: | | 0.1 m ³ |
| Comment on volumes: | The waste was accumulated in 1971. There will be no further arisings of this waste stream. | |
| Uncertainty factors on volumes: | Stock (upper): x 1.1 | Arisings (upper) x |
| | Stock (lower): x 0.9 | Arisings (lower) x |

WASTE SOURCE The waste is miscellaneous contaminated items arising at Berkeley Nuclear Laboratories (now Berkeley Technology Centre) from the examination of irradiated fuel, steel and graphite.

PHYSICAL CHARACTERISTICS

General description: The waste is miscellaneous contaminated combustible waste including tissues and paper contained in a thin walled mild steel black can liner of nominal length 1.219m and nominal diameter 0.343m. There are no large items that may require special handling.

Physical components (%vol): The waste consists of ~90% ferrous metals, ~5% paper/cotton and ~ 5% plastics.

Sealed sources: -

Bulk density (t/m³): 0.44

Comment on density: Calculated using mass of container and external volume.

CHEMICAL COMPOSITION

General description and components (%wt): The waste includes mild steel, paper and other materials.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Most tritium is expected to be present as water but some may be in the form of other inorganic compounds or as organic compounds.
C-14: Chemical form of carbon 14 has not been determined but may be graphite.
Cl-36: The chemical form of chlorine 36 in these wastes is not known.
U: Chemical form of uranium isotopes has not been determined but may be uranium oxides.
Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): The only metal present will be the thin walled mild steel black can liner.

| | |
|---------------------------|-------|
| Stainless steel..... | 0 |
| Other ferrous metals..... | ~90.0 |
| Iron..... | |
| Aluminium..... | 0 |
| Beryllium..... | NE |
| Cobalt..... | |
| Copper..... | 0 |
| Lead..... | 0 |
| Magnox/Magnesium..... | 0 |
| Nickel..... | |
| Titanium..... | |
| Uranium..... | |

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| | | | |
|-------------------------|--|------|----------------------------------|
| | Zinc..... | 0 | |
| | Zircaloy/Zirconium..... | 0 | |
| | Other metals..... | 0 | No other metals are anticipated. |
| Organics (%wt): | The waste is in the same vault section as the ion exchange materials, so there may be trace contamination with Lewatit DN. | | |
| | Total cellulosics..... | ~5.0 | |
| | Paper, cotton..... | ~5.0 | |
| | Wood..... | NE | |
| | Halogenated plastics | NE | |
| | Total non-halogenated plastics..... | ~0 | |
| | Condensation polymers..... | NE | |
| | Others..... | NE | |
| | Organic ion exchange materials.... | TR | |
| | Total rubber..... | NE | |
| | Halogenated rubber | NE | |
| | Non-halogenated rubber..... | NE | |
| | Hydrocarbons..... | | |
| | Oil or grease | | |
| | Fuel..... | | |
| | Asphalt/Tarmac (cont.coal tar)... | | |
| | Asphalt/Tarmac (no coal tar).... | | |
| | Bitumen..... | | |
| | Others..... | | |
| | Other organics..... | NE | |
| Other materials (%wt): | - | | |
| | Inorganic ion exchange materials. | TR | |
| | Inorganic sludges and flocs..... | 0 | |
| | Soil..... | 0 | |
| | Brick/Stone/Rubble..... | 0 | |
| | Cementitious material..... | 0 | |
| | Sand..... | | |
| | Glass/Ceramics..... | 0 | |
| | Graphite..... | NE | |
| | Desiccants/Catalysts..... | | |
| | Asbestos..... | 0 | |
| | Non/low friable..... | | |
| | Moderately friable..... | | |
| | Highly friable..... | | |
| | Free aqueous liquids..... | 0 | |
| | Free non-aqueous liquids..... | NE | |
| | Powder/Ash..... | 0 | |
| Inorganic anions (%wt): | Anions will probably not be present at concentrations greater than about 1% wt. | | |

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

Materials of interest for waste acceptance criteria:

Trace quantities of magnox and uranium hydride might be present.

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

Hazardous substances / non hazardous pollutants:

Toxic metals are not expected to be present but further assessment is needed to confirm this.

| | |
|-----------------------------|--|
| 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):

Yes

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Organic complexing agents may be present in small quantities.

Total complexing agents..... <1.0

PACKAGING AND CONDITIONING

Conditioning method:

This stream will be co-packaged with 9A25, 9A31, 9A39, 9A47, 9A52, and 9A60 in Type VI DCIC containers. Remainder of vault 1 waste streams will be co-packaged together in Concrete boxes (9A61, 9A62, 9A67, 9A32, 9A40, 9A48, 9A53, 9A73). Packages for vault 1 are assigned to 9A25, 9A32 & 9A73.

Plant Name:

-

Location:

Berkeley Site

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

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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): -

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing:

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

RADIOACTIVITY

Source: The waste has become contaminated from the processes concerned with the examination of irradiated fuel, steel and graphite at Berkeley Nuclear Laboratories (now Berkeley Technology Centre).

Uncertainty: The values quoted are indicative of the expected activities.

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: Specific activities were derived by estimation based upon available information.

Other information: Specific activity is a function of operating history.

WASTE STREAM

9A66

Miscellaneous Contaminated Items from Post Irradiation Examination

| 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 | 1.02E-03 | CC 2 | | | Gd 153 | | | 8 | |
| Be 10 | | 8 | | | Ho 163 | | | 8 | |
| C 14 | 1.00E-05 | CC 2 | | | Ho 166m | | | 8 | |
| Na 22 | | 8 | | | Tm 170 | | | 8 | |
| Al 26 | | 8 | | | Tm 171 | | | 8 | |
| Cl 36 | 7E-07 | CC 2 | | | Lu 174 | | | 8 | |
| Ar 39 | | 8 | | | Lu 176 | | | 8 | |
| Ar 42 | | 8 | | | Hf 178n | | | 8 | |
| K 40 | | 8 | | | Hf 182 | | | 8 | |
| Ca 41 | | 8 | | | Pt 193 | | | 8 | |
| Mn 53 | | 8 | | | Tl 204 | | | 8 | |
| Mn 54 | | 8 | | | Pb 205 | | | 8 | |
| Fe 55 | 1.87E-06 | CC 2 | | | Pb 210 | | | 8 | |
| Co 60 | 4.13E-05 | CC 2 | | | Bi 208 | | | 8 | |
| Ni 59 | 1E-06 | CC 2 | | | Bi 210m | | | 8 | |
| Ni 63 | 7.36E-05 | CC 2 | | | Po 210 | | | 8 | |
| Zn 65 | | 8 | | | Ra 223 | | | 8 | |
| Se 79 | 1.21E-08 | CC 2 | | | Ra 225 | | | 8 | |
| Kr 81 | | 8 | | | Ra 226 | | | 8 | |
| Kr 85 | | 8 | | | Ra 228 | | | 8 | |
| Rb 87 | | 8 | | | Ac 227 | | | 8 | |
| Sr 90 | 5.26E-03 | CC 2 | | | Th 227 | | | 8 | |
| Zr 93 | 6E-07 | CC 2 | | | Th 228 | | | 8 | |
| Nb 91 | | 8 | | | Th 229 | | | 8 | |
| Nb 92 | | 8 | | | Th 230 | | | 8 | |
| Nb 93m | 3.57E-07 | CC 2 | | | Th 232 | | | 8 | |
| Nb 94 | | 8 | | | Th 234 | 3E-07 | CC 2 | | |
| Mo 93 | | 8 | | | Pa 231 | | | 8 | |
| Tc 97 | | 8 | | | Pa 233 | 4.12E-08 | CC 2 | | |
| Tc 99 | 3E-06 | CC 2 | | | U 232 | | | 8 | |
| Ru 106 | | 8 | | | U 233 | | | 8 | |
| Pd 107 | | 8 | | | U 234 | 3.08E-07 | CC 2 | | |
| Ag 108m | <2.96E-06 | C 3 | | | U 235 | 7E-09 | CC 2 | | |
| Ag 110m | | 8 | | | U 236 | 4.00E-08 | CC 2 | | |
| Cd 109 | | 8 | | | U 238 | 3E-07 | CC 2 | | |
| Cd 113m | | 8 | | | Np 237 | 4.12E-08 | CC 2 | | |
| Sn 119m | | 8 | | | Pu 236 | | | 8 | |
| Sn 121m | | 8 | | | Pu 238 | 1.82E-04 | CC 2 | | |
| Sn 123 | | 8 | | | Pu 239 | 1.00E-04 | CC 2 | | |
| Sn 126 | 4.35E-08 | CC 2 | | | Pu 240 | 2.00E-04 | CC 2 | | |
| Sb 125 | | 8 | | | Pu 241 | 1.69E-03 | CC 2 | | |
| Sb 126 | 6.09E-09 | CC 2 | | | Pu 242 | 1E-07 | CC 2 | | |
| Te 125m | | 8 | | | Am 241 | 3.38E-04 | CC 2 | | |
| Te 127m | | 8 | | | Am 242m | 8.48E-07 | CC 2 | | |
| I 129 | 6E-09 | CC 2 | | | Am 243 | 3.00E-07 | CC 2 | | |
| Cs 134 | | 8 | | | Cm 242 | 7E-07 | CC 2 | | |
| Cs 135 | 1E-07 | CC 2 | | | Cm 243 | 1.51E-07 | CC 2 | | |
| Cs 137 | 5.30E-03 | CC 2 | | | Cm 244 | 1.27E-06 | CC 2 | | |
| Ba 133 | | 8 | | | Cm 245 | | | 8 | |
| La 137 | | 8 | | | Cm 246 | | | 8 | |
| La 138 | | 8 | | | Cm 248 | | | 8 | |
| Ce 144 | | 8 | | | Cf 249 | | | 8 | |
| Pm 145 | | 8 | | | Cf 250 | | | 8 | |
| Pm 147 | 8.42E-08 | CC 2 | | | Cf 251 | | | 8 | |
| Sm 147 | | 8 | | | Cf 252 | | | 8 | |
| Sm 151 | 1.82E-05 | CC 2 | | | Other a | | | | |
| Eu 152 | 1.07E-07 | CC 2 | | | Other b/g | | | | |
| Eu 154 | 7.58E-06 | CC 2 | | | Total a | 8.23E-04 | CC 2 | 0 | |
| Eu 155 | 3.65E-07 | CC 2 | | | Total b/g | 1.34E-02 | CC 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