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| WASTE STREAM | 5B360 | Contaminated Oils and Solvents ILW |
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SITE Dounreay
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Dounreay Site Restoration Limited
WASTE TYPE ILW
 Is the waste subject to Scottish Policy: Yes

WASTE VOLUMES

| | | Reported |
|---------------------------|---------------------------|-----------------------|
| Stocks: | At 1.4.2022..... | 162.0 m ³ |
| Future arisings - | 1.4.2022 - 31.3.2023..... | 0.7 m ³ |
| | 1.4.2023 - 31.3.2024..... | 0 m ³ |
| | 1.4.2024 - 31.3.2025..... | 0 m ³ |
| | 1.4.2025 - 31.3.2026..... | 1.9 m ³ |
| | 1.4.2026 - 31.3.2027..... | 8.3 m ³ |
| | 1.4.2027 - 31.3.2028..... | 2.6 m ³ |
| | 1.4.2028 - 31.3.2029..... | 0 m ³ |
| | 1.4.2029 - 31.3.2030..... | 0 m ³ |
| | 1.4.2030 - 31.3.2031..... | 0 m ³ |
| | 1.4.2031 - 31.3.2032..... | << 0.1 m ³ |
| | 1.4.2032 - 31.3.2033..... | < 0.1 m ³ |
| | 1.4.2033 - 31.3.2034..... | < 0.1 m ³ |
| | 1.4.2034 - 31.3.2035..... | < 0.1 m ³ |
| | 1.4.2035 - 31.3.2036..... | < 0.1 m ³ |
| | 1.4.2036 - 31.3.2037..... | < 0.1 m ³ |
| | 1.4.2037 - 31.3.2038..... | < 0.1 m ³ |
| | 1.4.2038 - 31.3.2039..... | < 0.1 m ³ |
| 1.4.2039 - 31.3.2040..... | << 0.1 m ³ | |
| Total future arisings: | | 13.6 m ³ |
| Total waste volume: | | 175.6 m ³ |

Comment on volumes: Mainly wastes arising from the storage tanks in the HALS and Evaporation plant plus solvent tank (stocks) + ILW liquids across site (arisings). Note that there has been an adjustment to the volumes between stocks and arisings. It should be noted that DSRL are currently using a provisional site programme and arisings dates are subject to change. Arisings consist of reprocessing solvents stored in tanks and miscellaneous oils/solvents generated within facilities. Stocks increase is due to the addition of contents of solvent held in tank within old incinerator facility. This was previously counted as arisings. Stocks are held mainly within the HALS and Evaporation Plant.

Uncertainty factors on volumes: Stock (upper): x 1.2 Arisings (upper) x 1.2
 Stock (lower): x 0.8 Arisings (lower) x 0.8

WASTE SOURCE Fuel reprocessing and miscellaneous types of oils/solvents from experiments/operations.

PHYSICAL CHARACTERISTICS

General description: The waste contains a variety of solvents and liquids held mainly in the HALS and Evaporation plant. There are no large items in the waste. Most liquids are held in tanks. Some of the solvent is held in stainless steel drums.

Physical components (%vol): Other Liquid (88.38%), Reactive chemicals (0.06%), Solvent (7.91%), Stainless steel (3.64%),

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 1.25

Comment on density: Based on PWI estimates

CHEMICAL COMPOSITION

General description and components (%wt): Other Liquid (70.71%), Reactive chemicals (0.05%), Solvent (6.33%), Stainless steel (22.91%),

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Chemical state: Neutral

Chemical form of radionuclides: H-3: Likely to be present as water.
 C-14: Likely to be present.
 Cl-36: Not known to be present.
 I-129: Likely to be present.
 Ra: Not known to be present.
 Th: Not known to be present.
 U: Likely to be present
 Np: Likely to be present
 Pu: Likely to be present.

Metals and alloys (%wt): -

| | (%wt) | Type(s) / Grade(s) with proportions | % | of total C14 activity |
|---------------------------|-------|-------------------------------------|---|-----------------------|
| Stainless steel..... | 22.9 | 316 Stainless steel container | | |
| Other ferrous metals..... | | | | |
| Iron..... | | | | |
| Aluminium..... | | | | |
| Beryllium..... | | | | |
| Cobalt..... | | | | |
| Copper..... | | | | |
| Lead..... | | | | |
| Magnox/Magnesium..... | | | | |
| Nickel..... | | | | |
| Titanium..... | | | | |
| Uranium..... | | | | |
| Zinc..... | | | | |
| Zircaloy/Zirconium..... | | | | |
| Other metals..... | | | | |

Organics (%wt): The waste consists of lightly contaminated TBP/OK reprocessing solvent, and other lightly contaminated liquids including solvents and oils.

| | (%wt) | Type(s) and comment | % | of total C14 activity |
|-------------------------------------|-------|---------------------|---|-----------------------|
| Total cellulose..... | | | | |
| Paper, cotton..... | | | | |
| Wood..... | | | | |
| Halogenated plastics | | | | |
| Total non-halogenated plastics..... | | | | |
| Condensation polymers..... | | | | |
| Others..... | | | | |
| Organic ion exchange materials.... | | | | |
| Total rubber..... | | | | |
| Halogenated rubber | | | | |
| Non-halogenated rubber..... | | | | |
| Hydrocarbons..... | P | | | |
| Oil or grease | P | | | |
| Fuel..... | | | | |
| Asphalt/Tarmac (cont.coal tar)... | | | | |
| Asphalt/Tarmac (no coal tar).... | | | | |

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| Bitumen..... | | |
| Others..... | | |
| Other organics..... | 77.1 | Lightly contaminated TBP/OK reprocessing solvent, and other lightly contaminated liquids including solvents and oils. |

Other materials (%wt): -

| | (%wt) | Type(s) and comment | % of total C14 activity |
|------------------------------------|-------|---------------------|-------------------------|
| Inorganic ion exchange materials.. | | | |
| Inorganic sludges and flocs..... | | | |
| Soil..... | | | |
| Brick/Stone/Rubble..... | | | |
| Cementitious material..... | | | |
| Sand..... | | | |
| Glass/Ceramics..... | | | |
| Graphite..... | | | |
| Desiccants/Catalysts..... | | | |
| Asbestos..... | | | |
| Non/low friable..... | | | |
| Moderately friable..... | | | |
| Highly friable..... | | | |
| Free aqueous liquids..... | P | | |
| Free non-aqueous liquids..... | P | | |
| Powder/Ash..... | | | |

Inorganic anions (%wt): Trace quantities of inorganic anions are present.

| | (%wt) | Type(s) and comment |
|----------------|-------|---------------------|
| Fluoride..... | TR | |
| Chloride..... | TR | |
| Iodide..... | TR | |
| Cyanide..... | 0 | |
| Carbonate..... | TR | |
| Nitrate..... | TR | |
| Nitrite..... | NE | |
| Phosphate..... | TR | |
| Sulphate..... | TR | |
| Sulphide..... | TR | |

Materials of interest for waste acceptance criteria: Quantities of substances are not estimated.

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| | (%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..... | | |
| Generating toxic gases..... | | |
| Reacting with water..... | 0 | |
| Higher activity particles..... | 0 | |
| Soluble solids as bulk chemical compounds..... | 0 | |

Hazardous substances / non hazardous pollutants: Traces of toxic metals may be present. Solvents (6.33%).

| | (%wt) | Type(s) and comment |
|-----------------------------|-------|---------------------|
| Acrylamide..... | | |
| Benzene..... | NE | |
| Chlorinated solvents..... | | |
| Formaldehyde..... | | |
| Organometallics..... | | |
| Phenol..... | NE | |
| Styrene..... | | |
| Tri-butyl phosphate..... | TR | |
| Other organophosphates..... | TR | |
| Vinyl chloride..... | NE | |
| Arsenic..... | NE | |
| Barium..... | | |
| Boron..... | NE | |
| Boron (in Boral)..... | | |
| Boron (non-Boral)..... | | |
| Cadmium..... | NE | |
| Caesium..... | | |
| Selenium..... | NE | |
| Chromium..... | NE | |
| Molybdenum..... | NE | |
| Thallium..... | | |
| Tin..... | NE | |
| Vanadium..... | NE | |

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Mercury compounds..... TR

Others..... NE

Electronic Electrical Equipment (EEE)

EEE Type 1.....

EEE Type 2.....

EEE Type 3.....

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt): Yes

(%wt) Type(s) and comment

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants..... The waste contains tributyl phosphate.

Total complexing agents..... 5.0

Potential for the waste to contain discrete items: No.

PACKAGING AND CONDITIONING

Conditioning method: The liquid waste will be treated to result in an acceptable product. Current strategy indicates that the waste will be transferred to a temporary cementation plant for cementation into 500L drums.

Plant Name: Temporary Cementation Plant

Location: Dounreay

Plant startup date: 2022

Total capacity (m³/y incoming waste): ~8.0

Target start date for packaging this stream: 2022

Throughput for this stream (m³/y incoming waste): ~0.8

Other information: -

| Likely container type: | Container | Waste packaged (%vol) | Waste loading (m ³) | Payload (m ³) | Number of packages |
|------------------------|------------|-----------------------|---------------------------------|---------------------------|--------------------|
| | 500 l drum | 100.0 | 0.256 | 0.47 | 687 |

Likely container type comment: The conditioning factor is expected to be about 2.0.

Range in container waste volume: -

Other information on containers: Stainless Steel. The container is likely to be manufactured from 316 stainless steel.

Likely conditioning matrix: Cement

Other information: -

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Conditioned density (t/m³): ~1.7
 Conditioned density comment: Density is likely to be around 1.7 t/m³ once conditioned and cemented.
 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: Aqueous + solvent wastes from MTR, DFR, PFR fuel reprocessing.
 Uncertainty: Consignors data used to develop specific activities. However the number of consignments are limited, increasing the scope of uncertainty. Also, no LoC data is available for this waste stream at this time.
 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: Based on PWI estimates. This combines the consignment data from each relevant facility. Stocks has been decayed from 2005 (based on CHILW consignment from the HALS and Evaporation Plant).
 Other information: Specific Activity has been derived from UKRWI 2019 data decayed to 2022

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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 | | | | | Gd 153 | | | | |
| Be 10 | | | | | Ho 163 | | | | |
| C 14 | 6.82E-07 | CC 2 | 6.83E-07 | CC 2 | 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 | | | | | Pb 205 | | | | |
| Fe 55 | 1.87E-07 | CC 2 | 2.15E-06 | CC 2 | Pb 210 | | 2.79E-13 | CC 2 | |
| Co 60 | 1.80E-05 | CC 2 | 8.98E-05 | CC 2 | Bi 208 | | | | |
| Ni 59 | 8.76E-06 | CC 2 | 8.76E-06 | CC 2 | Bi 210m | | | | |
| Ni 63 | 1.39E-05 | CC 2 | 1.53E-05 | CC 2 | Po 210 | | 1.68E-13 | CC 2 | |
| Zn 65 | | | | | Ra 223 | | 2.06E-11 | CC 2 | |
| Se 79 | | | | | Ra 225 | | 1.48E-20 | CC 2 | |
| Kr 81 | | | | | Ra 226 | | 9.27E-12 | CC 2 | |
| Kr 85 | | | | | Ra 228 | | 1.69E-15 | CC 2 | |
| Rb 87 | | | | | Ac 227 | | 2.23E-11 | CC 2 | |
| Sr 90 | 1.02E-03 | CC 2 | 1.40E-03 | CC 2 | Th 227 | | 2.10E-11 | CC 2 | |
| Zr 93 | | | | | Th 228 | | 4.89E-16 | CC 2 | |
| Nb 91 | | | | | Th 229 | | 1.58E-20 | CC 2 | |
| Nb 92 | | | | | Th 230 | | 1.43E-08 | CC 2 | |
| Nb 93m | 3.88E-06 | CC 2 | 2.72E-06 | CC 2 | Th 232 | | 1.05E-14 | CC 2 | |
| Nb 94 | 1.69E-08 | CC 2 | 1.70E-08 | CC 2 | Th 234 | | 7.12E-07 | CC 2 | |
| Mo 93 | 5.53E-06 | CC 2 | 5.54E-06 | CC 2 | Pa 231 | | 4.83E-10 | CC 2 | |
| Tc 97 | | | | | Pa 233 | | 3.38E-11 | CC 2 | |
| Tc 99 | | | | | U 232 | | | | |
| Ru 106 | | | | | U 233 | | 1.86E-16 | CC 2 | |
| Pd 107 | | | | | U 234 | 5.17E-04 | CC 2 | 5.17E-04 | CC 2 |
| Ag 108m | | | | | U 235 | 7.62E-06 | CC 2 | 7.62E-06 | CC 2 |
| Ag 110m | | | | | U 236 | 7.12E-05 | CC 2 | 7.12E-05 | CC 2 |
| Cd 109 | | | | | U 238 | 7.13E-07 | CC 2 | 7.13E-07 | CC 2 |
| Cd 113m | | | | | Np 237 | | 3.55E-11 | CC 2 | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | 9.37E-06 | CC 2 | 1.04E-05 | CC 2 |
| Sn 123 | | | | | Pu 239 | 3.33E-05 | CC 2 | 3.33E-05 | CC 2 |
| Sn 126 | | | | | Pu 240 | 1.03E-05 | CC 2 | 1.04E-05 | CC 2 |
| Sb 125 | 2.96E-07 | CC 2 | 3.38E-06 | CC 2 | Pu 241 | 2.93E-03 | CC 2 | 5.52E-03 | CC 2 |
| Sb 126 | | | | | Pu 242 | | | | |
| Te 125m | 6.87E-08 | CC 2 | 7.99E-07 | CC 2 | Am 241 | 1.34E-04 | CC 2 | 5.04E-05 | CC 2 |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | | | Am 243 | | | | |
| Cs 134 | 2.91E-06 | CC 2 | 3.78E-05 | CC 2 | Cm 242 | 3.62E-09 | CC 2 | 4.07E-09 | CC 2 |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | 2.69E-03 | CC 2 | 3.65E-03 | CC 2 | Cm 244 | 1.26E-06 | CC 2 | 2.10E-06 | CC 2 |
| Ba 133 | | | | | Cm 245 | | | | |
| La 137 | | | | | Cm 246 | | | | |
| La 138 | | | | | Cm 248 | 4.64E-05 | CC 2 | 4.62E-05 | CC 2 |
| Ce 144 | | | | | Cf 249 | | | | |
| Pm 145 | | | | | Cf 250 | | | | |
| Pm 147 | 2.15E-05 | CC 2 | 2.56E-04 | CC 2 | Cf 251 | | | | |
| Sm 147 | | | 7.65E-15 | CC 2 | Cf 252 | 2.22E-03 | CC 2 | 2.62E-02 | CC 2 |
| Sm 151 | 1.5E-04 | CC 2 | 1.66E-04 | CC 2 | Other a | | | 7.00E-11 | CC 2 |
| Eu 152 | 6.95E-06 | CC 2 | 1.36E-05 | CC 2 | Other b/g | | | 4.85E-03 | CC 2 |
| Eu 154 | 4.36E-05 | CC 2 | 1.23E-04 | CC 2 | Total a | 3.05E-03 | CC 2 | 2.70E-02 | CC 2 |
| Eu 155 | 1.81E-05 | CC 2 | 1.03E-04 | CC 2 | Total b/g | 6.93E-03 | CC 2 | 1.63E-02 | 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