## WASTE STREAM 7A112 Decommissioning LLW - Natural / Depleted Uranium

**SITE** AWE Aldermaston

**SITE OWNER** Ministry of Defence

**WASTE CUSTODIAN** AWE plc

**WASTE TYPE** LLW

**WASTE VOLUMES**

| | | Reported |
|---|---|---|
| Stocks: | At 1.4.2019..... | 0 m³ |
| Future arisings - | 1.4.2019 - 31.3.2022..... | 8.0 m³ |
| | 1.4.2022 - 31.3.2030..... | 0 m³ |
| | 1.4.2030 - 31.3.2034..... | 336.0 m³ |
| | 1.4.2034 - 31.3.2037..... | 548.0 m³ |
| | 1.4.2037 - 31.3.2040..... | 76.0 m³ |
| | 1.4.2040 - 31.3.2080..... | 0 m³ |
| Total future arisings: | | 968.0 m³ |
| Total waste volume: | | 968.0 m³ |

Comment on volumes: Future arisings are estimated based on recently reviewed decommissioning plans for facilities on site. The total volume of arisings will depend on the longevity of the AWE site, estimates have been made based on a site closure date of 2080. Stock volumes are accurate.

Uncertainty factors on volumes:

| | | | |
|---|---|---|---|
| Stock (upper): | x | Arisings (upper) | x 5.0 |
| Stock (lower): | x | Arisings (lower) | x 0.5 |

**WASTE SOURCE** Waste arising from natural and depleted uranium decommissioning operations.

### PHYSICAL CHARACTERISTICS

General description: The waste contains metal, celluosics, rubble, asbestos and plastics.

Physical components (%wt): Metal (84%), rubble (4%), plastics (7%), cellulosic (3%) and asbestos (2%). The physical components have been reviewed in 2019 and are consistent with the 2016 UK RWI data.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.53

Comment on density: Bulk density was calculated from disposals between 2016-2019. A small increase from the 2016 UK RWI.

### CHEMICAL COMPOSITION

General description and components (%wt): Metal (84%), rubble (4%), plastics (7%), cellulosic (3%) and asbestos (2%).

Chemical state: Neutral

Chemical form of radionuclides: U: Oxide.

Metals and alloys (%wt): The majority of decommissioning metal is sheets and pipes typically 4mm in thickness. The copper also includes cables.

| | |
|---|---|
| Stainless steel..... | 5.7 |
| Other ferrous metals..... | 78.1 |
| Iron..... | |
| Aluminium..... | 0.11 |
| Beryllium..... | TR |
| Cobalt..... | |
| Copper..... | 0.07 |
| Lead..... | TR |
| Magnox/Magnesium..... | |
| Nickel..... | |

| WASTE STREAM | 7A112 Decommissioning LLW - Natural / Depleted Uranium | | |
|---|---|---|---|
| | Titanium | 0 | |
| | Uranium | NE | Uranium is accounted for as a contaminant. |
| | Zinc | | |
| | Zircaloy/Zirconium | | |
| | Other metals | 0.12 | |
| Organics (%wt): | Filters included as cellulosic PVC. | | |
| | Total cellulosics | 3.5 | |
| | Paper, cotton | 0.32 | |
| | Wood | 3.2 | |
| | Halogenated plastics | 5.1 | PVC. |
| | Total non-halogenated plastics | 1.5 | |
| | Condensation polymers | 1.5 | |
| | Others | | |
| | Organic ion exchange materials | | |
| | Total rubber | 0.35 | |
| | Halogenated rubber | | |
| | Non-halogenated rubber | 0.35 | |
| | Hydrocarbons | | |
| | Oil or grease | | |
| | Fuel | | |
| | Asphalt/Tarmac (cont.coal tar) | | |
| | Asphalt/Tarmac (no coal tar) | | |
| | Bitumen | | |
| | Others | | |
| | Other organics | | |
| Other materials (%wt): | - | | |
| | Inorganic ion exchange materials. | | |
| | Inorganic sludges and flocs | | |
| | Soil | | |
| | Brick/Stone/Rubble | 3.8 | |
| | Cementitious material | | |
| | Sand | | |
| | Glass/Ceramics | | |
| | Graphite | | |
| | Desiccants/Catalysts | 0 | |
| | Asbestos | 1.7 | |
| | Non/low friable | | |
| | Moderately friable | | |
| | Highly friable | | |
| | Free aqueous liquids | | |
| | Free non-aqueous liquids | | |
| | Powder/Ash | | |

| WASTE STREAM | 7A112 | Decommissioning LLW - Natural / Depleted Uranium |
|---|---|---|

Inorganic anions (%wt): -

Fluoride.....

Chloride.....

Iodide.....

Cyanide.....

Carbonate.....

Nitrate.....

Nitrite.....

Phosphate.....

Sulphate.....

Sulphide.....

Materials of interest for waste acceptance criteria: This waste contains asbestos, beryllium and lead.

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

Hazardous substances / non hazardous pollutants: This waste contains asbestos, beryllium and lead.

| | | |
|---|---|---|
| Acrylamide..... | 0 | |
| Benzene..... | 0 | |
| Chlorinated solvents..... | 0 | |
| Formaldehyde..... | 0 | |
| Organometallics..... | 0 | |
| Phenol..... | 0 | |
| Styrene..... | 0 | |
| Tri-butyl phosphate..... | 0 | |
| Other organophosphates..... | 0 | |
| Vinyl chloride..... | P | PVC is present. |
| Arsenic..... | 0 | |
| Barium..... | 0 | |

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.....

**TREATMENT, PACKAGING AND DISPOSAL**

Planned on-site / off-site treatment(s):

| Treatment | On-site / Off site | Stream volume % |
|---|---|---|
| Low force compaction | | |
| Supercompaction (HFC) | | |
| Incineration | | |
| Solidification | | |
| Decontamination | | |
| Metal treatment | Off-site | ~40.0 |
| Size reduction | | |
| Decay storage | | |
| Recyling / reuse | | |
| Other / various | | |
| None | Off-site | ~60.0 |

Comment on planned treatments: The estimated percentage of wastes going to each treatment route has been based on disposals made in the last three years.

## WASTE STREAM 7A112 Decommissioning LLW - Natural / Depleted Uranium

**Disposal Routes:**

| Disposal Route | Stream volume % |
|---|---|
| Expected to be consigned to the LLW Repository | |
| Expected to be consigned to a Landfill Facility | ~60.0 |
| Expected to be consigned to an On-Site Disposal Facility | |
| Expected to be consigned to an Incineration Facility | |
| Expected to be consigned to a Metal Treatment Facility | ~40.0 |
| Expected to be consigned as Out of Scope | |
| Expected to be recycled / reused | |
| Disposal route not known | |

**Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):**

| Disposal Route | Stream volume % | | |
|---|---|---|---|
| | 2019/20 | 2020/21 | 2021/22 |
| Expected to be consigned to the LLW Repository | | | |
| Expected to be consigned to a Landfill Facility | | | |
| Expected to be consigned to an On-Site Disposal Facility | | | |
| Expected to be consigned to an Incineration Facility | | | |
| Expected to be consigned to a Metal Treatment Facility | | | |
| Expected to be consigned as Out of Scope | | | |
| Expected to be recycled / reused | | | |
| Disposal route not known | | | |

**Waste Packaging for Disposal:** (Not applicable to this waste stream)

| Container | Stream volume % | Waste loading m³ | Number of packages |
|---|---|---|---|
| 1/3 Height IP-1 ISO | | | |
| 2/3 Height IP-2 ISO | | | |
| 1/2 Height WAMAC IP-2 ISO | | | |
| 1/2 Height IP-2 Disposal/Re-usable ISO | | | |
| 2m box (no shielding) | | | |
| 4m box (no shielding) | | | |
| Other | | | |

Other information: No waste in this stream is expected to go to the LLWR.

**Waste Planned for Disposal at the LLW Repository:** (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: -

Potential for the waste to contain discrete items: -

**Non-Containerised Waste for In-Vault Grouting:** (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

**RADIOACTIVITY**

## WASTE STREAM 7A112 Decommissioning LLW - Natural / Depleted Uranium

| | |
|---|---|
| Source: | DU / NU |
| Uncertainty: | The gross alpha and gross beta activities of the in-stock wastes are accurate, the radionuclide breakdown has been estimated. The waste arising activities have been projected. |
| 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: | The fingerprints for these wastes are determined by the materials that have contaminated them, these are used with high resolution gamma spectrometry to assay the wastes. |
| Other information: | Decay nuclides with a half life of less than 3 months have been omitted. |

## WASTE STREAM 7A112 Decommissioning LLW - Natural / Depleted Uranium

| Nuclide | Mean radioactivity, TBq/m³ | | | | Nuclide | Mean radioactivity, TBq/m³ | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | Pb 205 | | | | |
| Fe 55 | | | | | Pb 210 | | | | |
| Co 60 | | | | | Bi 208 | | | | 5 |
| Ni 59 | | | | | Bi 210m | | | | |
| Ni 63 | | | | | Po 210 | | | | 5 |
| Zn 65 | | | | | Ra 223 | | | | 5 |
| Se 79 | | | | | Ra 225 | | | | 5 |
| Kr 81 | | | | | Ra 226 | | | | 5 |
| Kr 85 | | | | | Ra 228 | | | | 5 |
| Rb 87 | | | | | Ac 227 | | | | 5 |
| Sr 90 | | | | | Th 227 | | | | 5 |
| Zr 93 | | | | | Th 228 | | | | 5 |
| Nb 91 | | | | | Th 229 | | | | 5 |
| Nb 92 | | | | | Th 230 | | | | 5 |
| Nb 93m | | | | | Th 232 | | | | 5 |
| Nb 94 | | | | | Th 234 | | | | 5 |
| Mo 93 | | | | | Pa 231 | | | | 5 |
| Tc 97 | | | | | Pa 233 | | | | 5 |
| Tc 99 | | | | | U 232 | | | | |
| Ru 106 | | | | | U 233 | | | | |
| Pd 107 | | | | | U 234 | | | 4.58E-06 | C C 2 |
| Ag 108m | | | | | U 235 | | | 1.80E-07 | C C 2 |
| Ag 110m | | | | | U 236 | | | 1.59E-08 | C C 2 |
| Cd 109 | | | | | U 238 | | | 8.21E-06 | C C 2 |
| Cd 113m | | | | | Np 237 | | | | |
| Sn 119m | | | | | Pu 236 | | | | |
| Sn 121m | | | | | Pu 238 | | | | |
| Sn 123 | | | | | Pu 239 | | | | |
| Sn 126 | | | | | Pu 240 | | | | |
| Sb 125 | | | | | Pu 241 | | | | |
| Sb 126 | | | | | Pu 242 | | | | |
| Te 125m | | | | | Am 241 | | | | |
| Te 127m | | | | | Am 242m | | | | |
| I 129 | | | | | Am 243 | | | | |
| Cs 134 | | | | | Cm 242 | | | | |
| Cs 135 | | | | | Cm 243 | | | | |
| Cs 137 | | | | | Cm 244 | | | | |
| Ba 133 | | | | | Cm 245 | | | | |
| La 137 | | | | | Cm 246 | | | | |
| La 138 | | | | | Cm 248 | | | | |
| Ce 144 | | | | | 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 | | | | | **Total a** | **0** | | **1.30E-05** | **C C 2** |
| Eu 155 | | | | | **Total b/g** | **0** | | **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