

|                     |             |                           |
|---------------------|-------------|---------------------------|
| <b>WASTE STREAM</b> | <b>2C41</b> | <b>Fuel Skips in Pond</b> |
|---------------------|-------------|---------------------------|

**SITE** Chapelcross

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** LLW

**WASTE VOLUMES**

|                                 |  |                     |
|---------------------------------|--|---------------------|
|                                 |  | Reported            |
| Stocks:                         | At 1.4.2019.....   | 43.5 m <sup>3</sup> |
| Total future arisings:          |  | 0 m <sup>3</sup>    |
| Total waste volume:             |  | 43.5 m <sup>3</sup> |
| Comment on volumes:             | 34 skips: volume calculated as 0.9906 x 1.1811 x 1.0922 x 34 = 43.45m <sup>3</sup> |                     |
| Uncertainty factors on volumes: | Stock (upper): x 1.2   | Arisings (upper) x  |
|                                 | Stock (lower): x 0.8   | Arisings (lower) x  |

**WASTE SOURCE** Contamination from pond operations and plant operation.

**PHYSICAL CHARACTERISTICS**

General description: Skip dimensions are approximately 0.9906m x 1.1811m x 1.0922m

Physical components (%vol): Pond skips are made of mild steel and are coated in UPC paint.

Sealed sources: -

Bulk density (t/m<sup>3</sup>): 0.35

Comment on density: This has been calculated using a waste stream weight of 15.1 te and a volume of 43.45 m<sup>3</sup>

**CHEMICAL COMPOSITION**

General description and components (%wt): Steel and small amount of UPC paint. Fission products, actinides and other activation products will be present as contaminants.

Chemical state: Neutral

Chemical form of radionuclides:

- H-3: The tritium isotope content is insignificant.
- C-14: The carbon isotope content is insignificant.
- Se-79: The selenium content is insignificant.
- Tc-99: The technetium content is insignificant.
- Ra: The radium isotope content is insignificant.
- Th: The thorium isotope content is insignificant.
- U: The uranium isotope content is insignificant.
- Np: The neptunium content is insignificant.
- Pu: The chemical form of plutonium isotopes may be plutonium oxides.

Metals and alloys (%wt):

|  |      |                        |
|--|------|------------------------|
| Pond skips are constructed from 3.2 mm 10 gauge steel plate. |      |                        |
| Stainless steel.....   | 0    |                        |
| Other ferrous metals.....                                    | 96.8 | Mild steel composition |
| Iron.....  |      |                        |
| Aluminium.....   | 0    |                        |
| Beryllium.....   |      |                        |
| Cobalt.....  |      |                        |
| Copper.....  | 0    |                        |
| Lead.....  | 0    |                        |
| Magnox/Magnesium.....  | 0    |                        |
| Nickel.....  |      |                        |
| Titanium.....  |      |                        |
| Uranium.....   |      |                        |
| Zinc.....  | 1.2  | Zinc based primer      |

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|                         |   |     |               |
|-------------------------|---|-----|---------------|
|                         | Zircaloy/Zirconium.....                 | 0   |               |
|                         | Other metals.....                       | 0   |               |
| Organics (%wt):         | There may be organics in the UPC paint. |     |               |
|                         | Total cellulosics.....                  | 1.0 |               |
|                         | Paper, cotton.....                      | 1.0 | cardboard     |
|                         | Wood.....                               | 0   |               |
|                         | Halogenated plastics .....              | 0   |               |
|                         | Total non-halogenated plastics.....     | 1.0 |               |
|                         | Condensation polymers.....              | 0   |               |
|                         | Others.....                             | 1.0 | Polypropylene |
|                         | Organic ion exchange materials....      | 0   |               |
|                         | Total rubber.....                       | 0   |               |
|                         | Halogenated rubber .....                | 0   |               |
|                         | Non-halogenated rubber.....             | 0   |               |
|                         | 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.       | 0   |               |
|                         | Inorganic sludges and flocs.....        | 0   |               |
|                         | Soil.....                               | 0   |               |
|                         | Brick/Stone/Rubble.....                 | 0   |               |
|                         | Cementitious material.....              | 0   |               |
|                         | Sand.....                               |     |               |
|                         | Glass/Ceramics.....                     | 0   |               |
|                         | 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): | -                                       |     |               |

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

Materials of interest for waste acceptance criteria:

No materials likely to pose a fire or other non-radiological hazard have been identified.

|  |   |
|--|---|
| Combustible metals.....                        | 0 |
| Low flash point liquids.....                   | 0 |
| Explosive materials.....                       | 0 |
| Phosphorus.....                                | 0 |
| Hydrides.....                                  | 0 |
| 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.....                       | 0 |
| Active particles.....                          |   |
| Soluble solids as bulk chemical compounds..... |   |

Hazardous substances / non hazardous pollutants:

|                             |  |
|-----------------------------|--|
| -                           |  |
| 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..... NE

**TREATMENT, PACKAGING AND DISPOSAL**

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

| Treatment  | On-site / Off site | Stream volume % |
|--|--------------------|-----------------|
| Low force compaction<br>Supercompaction (HFC)<br>Incineration<br>Solidification<br>Decontamination<br>Metal treatment<br>Size reduction<br>Decay storage<br>Recycling / reuse<br>Other / various<br>None | On-site            | 100.0           |

Comment on planned treatments:

Skips will be cut to fit into containers. It is estimated that 24 skips can be packaged inside a HHISO container; 16 cut skips inside 8 whole skips.

**WASTE STREAM****2C41****Fuel Skips in Pond****Disposal Routes:**

| Disposal Route  | Stream volume % |
|---|-----------------|
| Expected to be consigned to the LLW Repository<br>Expected to be consigned to a Landfill Facility<br>Expected to be consigned to an On-Site Disposal Facility<br>Expected to be consigned to an Incineration Facility<br>Expected to be consigned to a Metal Treatment Facility<br>Expected to be consigned as Out of Scope<br>Expected to be recycled / reused<br>Disposal route not known | 100.0           |

**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<br>Expected to be consigned to a Landfill Facility<br>Expected to be consigned to an On-Site Disposal Facility<br>Expected to be consigned to an Incineration Facility<br>Expected to be consigned to a Metal Treatment Facility<br>Expected to be consigned as Out of Scope<br>Expected to be recycled / reused<br>Disposal route not known |                 |         |         |

**Waste Packaging for Disposal:**

| Container  | Stream volume % | Waste loading m <sup>3</sup> | Number of packages |
|--|-----------------|------------------------------|--------------------|
| 1/3 Height IP-1 ISO<br>2/3 Height IP-2 ISO<br>1/2 Height WAMAC IP-2 ISO<br>1/2 Height IP-2 Disposal/Re-usable ISO<br>2m box (no shielding)<br>4m box (no shielding)<br>Other | 100.0           | 30.67                        | 2                  |

Other information: -

**Waste Planned for Disposal at the LLW Repository:**

Container voidage: -

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).  
The waste has a current 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****2C41****Fuel Skips in Pond**

|   |   |
|---|---|
| Source:   | Contamination from pond operations and plant operation.   |
| 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:                 | Skip activities are taken from waste stream fingerprint in WCH LLWT-01-18-2019-02-01 and then decayed by two years to 01/04/2019.   |
| Other information:                              | -   |

**WASTE STREAM**

**2C41**

**Fuel Skips in Pond**

| Nuclide | Mean radioactivity, TBq/m <sup>3</sup> |                |                 |                | Nuclide          | Mean radioactivity, TBq/m <sup>3</sup> |                |                 |                |
|---------|--|----------------|-----------------|----------------|------------------|--|----------------|-----------------|----------------|
|         | 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     | 8.89E-06                               | CC 1           |                 |                | Gd 153           |  | 8              |                 |                |
| Be 10   |  | 8              |                 |                | Ho 163           |  | 8              |                 |                |
| C 14    | 4.06E-06                               | CC 1           |                 |                | Ho 166m          |  | 8              |                 |                |
| Na 22   |  | 8              |                 |                | Tm 170           |  | 8              |                 |                |
| Al 26   |  | 8              |                 |                | Tm 171           |  | 8              |                 |                |
| Cl 36   | 1.43E-08                               | CC 1           |                 |                | 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   | 3.43E-07                               | CC 1           |                 |                | Pb 210           |  | 8              |                 |                |
| Co 60   | 1.08E-06                               | CC 2           |                 |                | Bi 208           |  | 8              |                 |                |
| Ni 59   |  | 8              |                 |                | Bi 210m          |  | 8              |                 |                |
| Ni 63   | 7.71E-07                               | CC 1           |                 |                | Po 210           |  | 8              |                 |                |
| Zn 65   |  | 8              |                 |                | Ra 223           |  | 8              |                 |                |
| Se 79   |  | 8              |                 |                | Ra 225           |  | 8              |                 |                |
| Kr 81   |  | 8              |                 |                | Ra 226           |  | 8              |                 |                |
| Kr 85   |  | 8              |                 |                | Ra 228           |  | 8              |                 |                |
| Rb 87   |  | 8              |                 |                | Ac 227           |  | 8              |                 |                |
| Sr 90   | 1.65E-03                               | CC 1           |                 |                | Th 227           |  | 8              |                 |                |
| Zr 93   |  | 8              |                 |                | Th 228           | 5.05E-09                               | CC 2           |                 |                |
| Nb 91   |  | 8              |                 |                | Th 229           |  | 8              |                 |                |
| Nb 92   |  | 8              |                 |                | Th 230           |  | 8              |                 |                |
| Nb 93m  |  | 8              |                 |                | Th 232           |  | 8              |                 |                |
| Nb 94   |  | 8              |                 |                | Th 234           | 2.09E-08                               | CC 2           |                 |                |
| Mo 93   |  | 8              |                 |                | Pa 231           |  | 8              |                 |                |
| Tc 97   |  | 8              |                 |                | Pa 233           |  | 8              |                 |                |
| Tc 99   | 4.29E-07                               | CC 1           |                 |                | U 232            | 9.71E-09                               | CC 1           |                 |                |
| Ru 106  | 1.22E-08                               | CC 2           |                 |                | U 233            |  | 8              |                 |                |
| Pd 107  |  | 8              |                 |                | U 234            | 2.13E-08                               | CC 1           |                 |                |
| Ag 108m |  | 8              |                 |                | U 235            |  | 8              |                 |                |
| Ag 110m |  | 8              |                 |                | U 236            |  | 8              |                 |                |
| Cd 109  |  | 8              |                 |                | U 238            | 2.09E-08                               | CC 1           |                 |                |
| Cd 113m |  | 8              |                 |                | Np 237           |  | 8              |                 |                |
| Sn 119m |  | 8              |                 |                | Pu 236           |  | 8              |                 |                |
| Sn 121m |  | 8              |                 |                | Pu 238           | 1.12E-05                               | CC 1           |                 |                |
| Sn 123  |  | 8              |                 |                | Pu 239           | 7.1E-06                                | CC 1           |                 |                |
| Sn 126  |  | 8              |                 |                | Pu 240           | 8.73E-06                               | CC 1           |                 |                |
| Sb 125  | 1.7E-07                                | CC 2           |                 |                | Pu 241           | 3.88E-04                               | CC 1           |                 |                |
| Sb 126  |  | 8              |                 |                | Pu 242           | 6.9E-09                                | CC 2           |                 |                |
| Te 125m | 4.26E-08                               | CC 2           |                 |                | Am 241           | 6.66E-05                               | CC 1           |                 |                |
| Te 127m |  | 8              |                 |                | Am 242m          |  | 8              |                 |                |
| I 129   |  | 8              |                 |                | Am 243           |  | 8              |                 |                |
| Cs 134  | 3.27E-07                               | CC 2           |                 |                | Cm 242           |  | 8              |                 |                |
| Cs 135  |  | 8              |                 |                | Cm 243           | 1.17E-08                               | CC 1           |                 |                |
| Cs 137  | 6.91E-04                               | CC 2           |                 |                | Cm 244           | 2.66E-07                               | CC 1           |                 |                |
| Ba 133  |  | 8              |                 |                | Cm 245           |  | 8              |                 |                |
| La 137  |  | 8              |                 |                | Cm 246           |  | 8              |                 |                |
| La 138  |  | 8              |                 |                | Cm 248           |  | 8              |                 |                |
| Ce 144  | 1.25E-09                               | CC 2           |                 |                | Cf 249           |  | 8              |                 |                |
| Pm 145  |  | 8              |                 |                | Cf 250           |  | 8              |                 |                |
| Pm 147  | 1.86E-06                               | CC 1           |                 |                | Cf 251           |  | 8              |                 |                |
| Sm 147  |  | 8              |                 |                | Cf 252           |  | 8              |                 |                |
| Sm 151  | 8.16E-06                               | CC 1           |                 |                | Other a          |  |                |                 |                |
| Eu 152  | 8.81E-08                               | CC 2           |                 |                | Other b/g        |  |                |                 |                |
| Eu 154  | 2.64E-06                               | CC 2           |                 |                | <b>Total a</b>   | <b>9.40E-05</b>                        | <b>CC 2</b>    | <b>0</b>        |                |
| Eu 155  | 6.71E-07                               | CC 2           |                 |                | <b>Total b/g</b> | <b>2.76E-03</b>                        | <b>CC 2</b>    | <b>0</b>        |                |

**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