

|                     |             |                            |
|---------------------|-------------|----------------------------|
| <b>WASTE STREAM</b> | <b>3L13</b> | <b>Gas Circulators LLW</b> |
|---------------------|-------------|----------------------------|

**SITE** Heysham 1

**SITE OWNER** EDFE NGL

**WASTE CUSTODIAN** EDFE NGL

**WASTE TYPE** LLW

**WASTE VOLUMES**

|                        |                           | Reported             |
|------------------------|---------------------------|----------------------|
| Stocks:                | At 1.4.2019.....          | 31.2 m <sup>3</sup>  |
| Future arisings -      | 1.4.2019 - 31.3.2023..... | 15.8 m <sup>3</sup>  |
|                        | 1.4.2023 - 31.3.2024..... | 14.5 m <sup>3</sup>  |
|                        | 1.4.2024 - 31.3.2025..... | 22.0 m <sup>3</sup>  |
|                        | 1.4.2025 - 31.3.2027..... | 43.9 m <sup>3</sup>  |
|                        | 1.4.2027 - 31.3.2028..... | 27.7 m <sup>3</sup>  |
| Total future arisings: |                           | 124.0 m <sup>3</sup> |
| Total waste volume:    |                           | 155.2 m <sup>3</sup> |

Comment on volumes: Waste volumes will be variable depending on station operating conditions.

Uncertainty factors on volumes: Stock (upper): x 1.25 Arisings (upper) x 1.5  
 Stock (lower): x 0.75 Arisings (lower) x 0.5

**WASTE SOURCE** General solid LLW arisings from the Heysham 1 Reactor Building Gas Circulator maintenance areas, and auxillary gas circuit areas.

**PHYSICAL CHARACTERISTICS**

General description: Hard and soft trash. Waste that cannot be packed into 200l drums will be placed in half height iso containers.

Physical components (%wt): Metal (~44%), Plastic/rubber (~34%), Wood, paper and cloth (~19%), a small amount of concrete and lagging/insulation (~3%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~0.51

Comment on density: Density based on conditioned volume in the WCF.

**CHEMICAL COMPOSITION**

General description and components (%wt): Metal (~44%), Plastic/rubber (~34%), Wood, paper and cloth (~19%), a small amount of concrete and lagging/insulation (~3%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritiated water or elemental (diffused into surfaces).  
 C-14: Activation of Graphite or carbon in metals  
 Cl-36: Not assessed  
 Se-79: Not expected to be significant  
 Tc-99: Not expected to be significant  
 I-129: Not assessed  
 Ra: Not expected to be significant  
 Th: Not expected to be significant  
 U: Not assessed  
 Np: Not expected to be significant  
 Pu: Not assessed

Metals and alloys (%wt): Metal thickness will be variable.

|                           |       |
|---------------------------|-------|
| Stainless steel.....      | ~20.0 |
| Other ferrous metals..... | ~24.0 |
| Iron.....                 | NE    |
| Aluminium.....            | NE    |
| Beryllium.....            | NE    |
| Cobalt.....               | NE    |
| Copper.....               | NE    |

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|                        |   |       |                    |
|------------------------|---|-------|--------------------|
|                        | Lead.....   | 0     |                    |
|                        | Magnox/Magnesium.....   | NE    |                    |
|                        | Nickel.....   | NE    |                    |
|                        | Titanium.....   | NE    |                    |
|                        | Uranium.....  | NE    |                    |
|                        | Zinc.....   | NE    |                    |
|                        | Zircaloy/Zirconium.....   | NE    |                    |
|                        | Other metals.....   | NE    |                    |
| Organics (%wt):        | The waste contains non-halogenated plastic as polythene (11% vol). PVC is not allowed in controlled areas. Oil and grease may be present. |       |                    |
|                        | Total cellulosics.....  | ~19.0 |                    |
|                        | Paper, cotton.....  | ~16.0 |                    |
|                        | Wood.....   | ~3.0  |                    |
|                        | Halogenated plastics .....  | NE    |                    |
|                        | Total non-halogenated plastics.....   | ~31.0 |                    |
|                        | Condensation polymers.....  | NE    |                    |
|                        | Others.....   | ~31.0 | Polythene (11%vol) |
|                        | Organic ion exchange materials....  | 0     |                    |
|                        | Total rubber.....   | ~3.0  |                    |
|                        | Halogenated rubber .....  | NE    |                    |
|                        | Non-halogenated rubber.....   | ~3.0  |                    |
|                        | Hydrocarbons.....   | NE    |                    |
|                        | Oil or grease .....   |       |                    |
|                        | Fuel.....   |       |                    |
|                        | Asphalt/Tarmac (cont.coal tar)...   |       |                    |
|                        | Asphalt/Tarmac (no coal tar)....  |       |                    |
|                        | Bitumen.....  |       |                    |
|                        | Others.....   |       |                    |
|                        | Other organics.....   | NE    |                    |
| Other materials (%wt): | Lagging/Insulation is expected to be present as ceramics (~2%)  |       |                    |
|                        | Inorganic ion exchange materials.   | 0     |                    |
|                        | Inorganic sludges and flocs.....  | 0     |                    |
|                        | Soil.....   | 0     |                    |
|                        | Brick/Stone/Rubble.....   | 0     |                    |
|                        | Cementitious material.....  | ~1.0  |                    |
|                        | Sand.....   | NE    |                    |
|                        | Glass/Ceramics.....   | 2.0   |                    |
|                        | Graphite.....   | 0     |                    |
|                        | Desiccants/Catalysts.....   | NE    |                    |
|                        | Asbestos.....   | 0     |                    |
|                        | Non/low friable.....  |       |                    |
|                        | Moderately friable.....   |       |                    |
|                        | Highly friable.....   |       |                    |

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|  |  |    |              |
|--|--|----|--------------|
|  | Free aqueous liquids.....                      | 0  |              |
|  | Free non-aqueous liquids.....                  | 0  |              |
|  | Powder/Ash.....                                | 0  |              |
| Inorganic anions (%wt):                              | Not estimated.                                 |    |              |
|  | Fluoride.....                                  | NE |              |
|  | Chloride.....                                  | NE |              |
|  | Iodide.....                                    | NE |              |
|  | Cyanide.....                                   | NE |              |
|  | Carbonate.....                                 | NE |              |
|  | Nitrate.....                                   | NE |              |
|  | Nitrite.....                                   | NE |              |
|  | Phosphate.....                                 | NE |              |
|  | Sulphate.....                                  | NE |              |
|  | Sulphide.....                                  | NE |              |
| Materials of interest for waste acceptance criteria: | -  |    |              |
|  | 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.....                      | 0  |              |
|  | Generating toxic gases.....                    | 0  |              |
|  | Reacting with water.....                       | 0  |              |
|  | Active particles.....                          | 0  | Not expected |
|  | Soluble solids as bulk chemical compounds..... | 0  |              |
| Hazardous substances / non hazardous pollutants:     | -  |    |              |
|  | Acrylamide.....                                | NE |              |
|  | Benzene.....                                   | NE |              |
|  | Chlorinated solvents.....                      | NE |              |
|  | Formaldehyde.....                              | NE |              |
|  | Organometallics.....                           | NE |              |
|  | Phenol.....                                    | 0  |              |
|  | Styrene.....                                   | NE |              |
|  | Tri-butyl phosphate.....                       | 0  |              |
|  | Other organophosphates.....                    | NE |              |

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|                                       |                    |
|---------------------------------------|--------------------|
| Vinyl chloride.....                   | 0                  |
| Arsenic.....                          | 0                  |
| Barium.....                           | NE                 |
| Boron.....                            | 0                  |
| Cadmium.....                          | 0                  |
| Caesium.....                          | NE                 |
| Selenium.....                         | NE                 |
| Chromium.....                         | 0                  |
| Molybdenum.....                       | 0                  |
| Thallium.....                         | NE                 |
| Tin.....                              | 0                  |
| Vanadium.....                         | 0                  |
| Mercury compounds.....                | 0                  |
| Others.....                           | NE                 |
| Electronic Electrical Equipment (EEE) |                    |
| EEE Type 1.....                       | 0                  |
| EEE Type 2.....                       | 0                  |
| EEE Type 3.....                       | 0                  |
| EEE Type 4.....                       | 0                  |
| EEE Type 5.....                       | 0                  |
| Complexing agents (%wt):              | Not yet determined |
| EDTA.....                             | NE                 |
| DPTA.....                             | NE                 |
| NTA.....                              | NE                 |
| Polycarboxylic acids.....             | NE                 |
| Other organic complexants.....        | NE                 |
| Total complexing agents.....          | TR                 |

**TREATMENT, PACKAGING AND DISPOSAL**

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

| Treatment             | On-site / Off site | Stream volume % |
|-----------------------|--------------------|-----------------|
| Low force compaction  |                    |                 |
| Supercompaction (HFC) | Off-site           | ~20.0           |
| Incineration          | Off-site           | ~50.0           |
| Solidification        | On-site            | <10.0           |
| Decontamination       | On-site            | ~5.0            |
| Metal treatment       |                    |                 |
| Size reduction        |                    |                 |
| Decay storage         |                    |                 |
| Recycling / reuse     |                    |                 |
| Other / various       |                    |                 |
| None                  |                    | ~15.0           |

Comment on planned treatments:

In line with the waste hierarchy, wastes will be treated preferentially by incineration, metal decontamination/melting, supercompaction, optimal packaging in HHISOs or immobilisation by encapsulation where necessary, prior to ultimate disposal at the LLW Repository. These treatments will be carried out off-site under contract with companies such as LLWR Ltd, EDF Cyclife, Tradebe and Inutec. The percentages are based on the history of consignments across the fleet of EDF Energy Nuclear Generation stations.

**Disposal Routes:**

| Disposal Route   | Stream volume % |
|--|-----------------|
| Expected to be consigned to the LLW Repository           | 45.0            |
| 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     | 50.0            |
| Expected to be consigned to a Metal Treatment Facility   |                 |
| Expected to be consigned as Out of Scope                 |                 |
| Expected to be recycled / reused                         | 5.0             |
| 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:**

| Container                              | Stream volume % | Waste loading m <sup>3</sup> | 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 | 45.0            | ~13.55                       | 6                  |
| 2m box (no shielding)                  |                 |                              |                    |
| 4m box (no shielding)                  |                 |                              |                    |
| Other                                  |                 |                              |                    |

Other information:

Waste loading is representative of the raw waste following further planned treatments. The waste will be reduced to 50% of its original waste volume after further planned treatments.

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|   |  |
|---|--|
| Container voidage:  | -  |
| Waste Characterisation Form (WCH):                          | The waste meets the LLWR's Waste Acceptance Criteria (WAC).<br>The waste has a current WCH.<br>Inventory information is consistent with the current WCH. |
| Waste consigned for disposal to LLWR in year of generation: | Yes. Routinely sent for LLWR disposal.   |
| Potential for the waste to contain discrete items:          | Yes  |

**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**

|   |   |
|---|---|
| Source:   | Mainly activation products including tritium.   |
| Uncertainty:                                    | Specific activity is a function of station operating history. The values quoted are indicative of the activities that would be expected.  |
| 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:                 | Activity based on fingerprint of waste stream.  |
| Other information:                              | -   |

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| 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     | 5.47E-04                               | CC 2           | 5.47E-04        | CC 2           | Gd 153           |  |                |                 |                |
| Be 10   |  | 8              |                 | 8              | Ho 163           |  |                |                 |                |
| C 14    | 5.81E-05                               | CC 2           | 5.81E-05        | CC 2           | Ho 166m          |  |                |                 |                |
| Na 22   |  | 4              |                 | 4              | Tm 170           |  |                |                 |                |
| Al 26   |  | 4              |                 | 4              | Tm 171           |  |                |                 |                |
| Cl 36   | 2.25E-05                               | CC 2           | 2.25E-05        | CC 2           | Lu 174           |  |                |                 |                |
| Ar 39   |  |                |                 |                | Lu 176           |  |                |                 |                |
| Ar 42   |  |                |                 |                | Hf 178n          |  |                |                 |                |
| K 40    |  |                |                 |                | Hf 182           |  |                |                 |                |
| Ca 41   |  | 8              |                 | 8              | Pt 193           |  |                |                 |                |
| Mn 53   |  |                |                 |                | Tl 204           |  |                |                 |                |
| Mn 54   | 1.71E-04                               | CC 2           | 1.71E-04        | CC 2           | Pb 205           |  |                |                 |                |
| Fe 55   | 8.94E-04                               | CC 2           | 8.94E-04        | CC 2           | Pb 210           |  | 8              |                 | 8              |
| Co 60   | 1.01E-04                               | CC 2           | 1.01E-04        | CC 2           | Bi 208           |  |                |                 |                |
| Ni 59   |  | 8              |                 | 8              | Bi 210m          |  |                |                 |                |
| Ni 63   | 1.24E-04                               | CC 2           | 1.24E-04        | CC 2           | Po 210           |  | 8              |                 | 8              |
| Zn 65   | 1.81E-06                               | CC 2           | 1.81E-06        | CC 2           | Ra 223           |  |                |                 |                |
| Se 79   |  | 8              |                 | 8              | Ra 225           |  |                |                 |                |
| Kr 81   |  |                |                 |                | Ra 226           |  | 8              |                 | 8              |
| Kr 85   |  |                |                 |                | Ra 228           |  |                |                 |                |
| Rb 87   |  |                |                 |                | Ac 227           |  |                |                 |                |
| Sr 90   | 1.77E-07                               | CC 2           | 1.77E-07        | CC 2           | Th 227           |  |                |                 |                |
| Zr 93   |  | 8              |                 | 8              | Th 228           |  |                |                 |                |
| Nb 91   |  |                |                 |                | Th 229           |  | 8              |                 | 8              |
| Nb 92   |  |                |                 |                | Th 230           |  | 8              |                 | 8              |
| Nb 93m  |  | 8              |                 | 8              | Th 232           |  | 8              |                 | 8              |
| Nb 94   | 2.09E-07                               | CC 2           | 2.09E-07        | CC 2           | Th 234           |  |                |                 |                |
| Mo 93   |  | 8              |                 | 8              | Pa 231           |  | 8              |                 | 8              |
| Tc 97   |  |                |                 |                | Pa 233           |  |                |                 |                |
| Tc 99   |  | 8              |                 | 8              | U 232            |  |                |                 |                |
| Ru 106  | 8.03E-07                               | CC 2           | 8.03E-07        | CC 2           | U 233            |  | 8              |                 | 8              |
| Pd 107  |  | 8              |                 | 8              | U 234            | 1.53E-10                               | CC 2           | 1.53E-10        | CC 2           |
| Ag 108m | 1.80E-07                               | CC 2           | 1.80E-07        | CC 2           | U 235            | 2.44E-12                               | CC 2           | 2.44E-12        | CC 2           |
| Ag 110m | 7.84E-08                               | CC 2           | 7.84E-08        | CC 2           | U 236            | 3.90E-11                               | CC 2           | 3.90E-11        | CC 2           |
| Cd 109  |  |                |                 |                | U 238            | 4.53E-11                               | CC 2           | 4.53E-11        | CC 2           |
| Cd 113m |  |                |                 |                | Np 237           |  | 8              |                 | 8              |
| Sn 119m |  |                |                 |                | Pu 236           |  |                |                 |                |
| Sn 121m |  | 8              |                 | 8              | Pu 238           | 7.33E-08                               | CC 2           | 7.33E-08        | CC 2           |
| Sn 123  |  |                |                 |                | Pu 239           | 2.73E-08                               | CC 2           | 2.73E-08        | CC 2           |
| Sn 126  |  | 8              |                 | 8              | Pu 240           | 6.48E-08                               | CC 2           | 6.48E-08        | CC 2           |
| Sb 125  | 8.86E-08                               | CC 2           | 8.86E-08        | CC 2           | Pu 241           | 2.71E-06                               | CC 2           | 2.71E-06        | CC 2           |
| Sb 126  |  |                |                 |                | Pu 242           |  | 8              |                 | 8              |
| Te 125m |  |                |                 |                | Am 241           | 1.37E-07                               | CC 2           | 1.37E-07        | CC 2           |
| Te 127m |  |                |                 |                | Am 242m          |  | 8              |                 | 8              |
| I 129   | 9.09E-13                               | CC 2           | 9.09E-13        | CC 2           | Am 243           |  | 8              |                 | 8              |
| Cs 134  | 9.93E-07                               | CC 2           | 9.93E-07        | CC 2           | Cm 242           | 1.19E-08                               | CC 2           | 1.19E-08        | CC 2           |
| Cs 135  |  | 8              |                 | 8              | Cm 243           | 5.68E-10                               | CC 2           | 5.68E-10        | CC 2           |
| Cs 137  | 3.26E-06                               | CC 2           | 3.26E-06        | CC 2           | Cm 244           | 5.28E-08                               | CC 2           | 5.28E-08        | CC 2           |
| Ba 133  | 2.49E-07                               | CC 2           | 2.49E-07        | CC 2           | Cm 245           |  | 8              |                 | 8              |
| La 137  |  |                |                 |                | Cm 246           |  | 8              |                 | 8              |
| La 138  |  |                |                 |                | Cm 248           |  |                |                 |                |
| Ce 144  | 2.74E-07                               | CC 2           | 2.74E-07        | CC 2           | Cf 249           |  |                |                 |                |
| Pm 145  |  |                |                 |                | Cf 250           |  |                |                 |                |
| Pm 147  | 2.78E-08                               | CC 2           | 2.78E-08        | CC 2           | Cf 251           |  |                |                 |                |
| Sm 147  |  |                |                 |                | Cf 252           |  |                |                 |                |
| Sm 151  |  |                |                 |                | Other a          |  | 6              |                 | 6              |
| Eu 152  | 4.96E-07                               | CC 2           | 4.96E-07        | CC 2           | Other b/g        | 1.34E-05                               | CC 2           | 1.34E-05        | CC 2           |
| Eu 154  | 4.76E-07                               | CC 2           | 4.76E-07        | CC 2           | <b>Total a</b>   | <b>3.68E-07</b>                        | <b>CC 2</b>    | <b>3.68E-07</b> | <b>CC 2</b>    |
| Eu 155  | 5.97E-08                               | CC 2           | 5.97E-08        | CC 2           | <b>Total b/g</b> | <b>1.94E-03</b>                        | <b>CC 2</b>    | <b>1.94E-03</b> | <b>CC 2</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