SITE Dungeness A

SITE OWNER **Nuclear Decommissioning Authority** 

**WASTE CUSTODIAN** Magnox Limited

LLW **WASTE TYPE** 

Is the waste subject to

Scottish Policy:

Nο

**WASTE VOLUMES** 

Reported Stocks: At 1.4.2022.....  $0 \, \text{m}^3$ Future arisings -1.4.2092 - 31.3.2095...... 457.0 m<sup>3</sup> 457.0 m<sup>3</sup> Total future arisings: Total waste volume: 457.0 m<sup>3</sup>

Comment on volumes: For inventory purposes the arisings are assumed to arise at a uniform rate over three years.

Final Dismantling & Site Clearance is assumed to commence in 2088 with reactor dismantling commencing in 2092 and lasting for 3 years. The volumes and radioactivity

have been calculated for 85 years after reactor shutdown, i.e. 2091.

Uncertainty factors on

Stock (upper):

Arisings (upper)

volumes:

Stock (lower):

Arisings (lower)

x 0.8

**WASTE SOURCE** Mild steel items from the reactor structure.

#### PHYSICAL CHARACTERISTICS

General description: A variety of mild steel items including the pressure vessel. Waste can be packaged in

standard LLW containers.

Physical components (%wt): Mild steel items (100%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m3): ~1.4

Comment on density: The density is of the waste as cut for packaging.

#### CHEMICAL COMPOSITION

General description and components (%wt):

Mild steel (100%).

Chemical state: Neutral

Chemical form of H-3: The tritium content is insignificant.

radionuclides: C-14: The carbon 14 is incorporated in the steel. There also may be some contamination

as graphite.

CI-36: The chlorine 36 will be incorporated in the steel.

Se-79: The selenium content is insignificant.

Tc-99: The chemical form of technetium has not been determined.

Ra: The radium content is insignificant. Th: The thorium content is insignificant. U: The uranium content is insignificant. Np: The neptunium content is insignificant. Pu: The plutonium content is insignificant.

Metals and alloys (%wt): All of the waste will be bulk metal items which have been cut for packaging. Metal

thicknesses will probably range from a few mm to about 100 mm.

% of total C14 (%wt) Type(s) / Grade(s) with proportions activity Stainless steel..... Other ferrous metals..... 100.0 Mild steel types are BS150E-171, 100.0

BS1501, BS15 and PV Steel (Coltuf

28).

Iron..... Aluminium...... 0

| Beryllium                                 | 0           |  |                         |
|---|-------------|--|-------------------------|
| Cobalt                                    | ~0.01       | Greatest measured value from the various components. |                         |
| Copper                                    | 0           |  |                         |
| Lead                                      | 0           |  |                         |
| Magnox/Magnesium                          | 0           |  |                         |
| Nickel                                    | <0.10       | Greatest measured value from the various components. |                         |
| Titanium                                  |             |  |                         |
| Uranium                                   |             |  |                         |
| Zinc                                      | 0           |  |                         |
| Zircaloy/Zirconium                        | 0           |  |                         |
| Other metals                              | TR          | Silver and niobium.                                  |                         |
| Organics (%wt): None expected. The        | re are no h | alogenated plastics and rubbers present.             |                         |
|   | (%wt)       | Type(s) and comment                                  | % of total C14 activity |
| Total cellulosics                         | 0           |  | donvity                 |
| Paper, cotton                             | 0           |  |                         |
| Wood                                      | 0           |  |                         |
| Halogenated plastics                      | 0           |  |                         |
| Total non-halogenated plastics            | 0           |  |                         |
| Condensation polymers                     | 0           |  |                         |
| Others                                    | 0           |  |                         |
| 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                            | 0           |  |                         |
| Other materials (%wt): Some graphite dust | may be ass  | sociated with reactor materials.                     |                         |
|   | (%wt)       | Type(s) and comment                                  | % of total C14          |
| Inorganic ion exchange materials          | 0           |  | activity                |
| Inorganic sludges and flocs               | 0           |  |                         |
| Soil                                      | 0           |  |                         |
| Brick/Stone/Rubble                        | 0           |  |                         |
| Cementitious material                     | 0           |  |                         |
| Sand                                      |             |  |                         |

| Glass/Ceramics   | 0            |  |
|--|--------------|--|
| Graphite   | TR           |  |
| 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): There may be a trace                             | ce of chlori | ide present.   |
| •  | (%wt)        | Type(s) and comment  |
| Fluoride   | 0            |  |
| Chloride   | TR           |  |
| lodide   | 0            |  |
| Cyanide  | 0            |  |
| Carbonate  | 0            |  |
| Nitrate  | 0            |  |
| Nitrite  | 0            |  |
| Phosphate  | 0            |  |
| Sulphate   | 0            |  |
| Sulphide   | 0            |  |
| Materials of interest for No materials likely waste acceptance criteria: | to pose a fi | ire or other non-radiological hazard have been identified. |
| waste acceptance cinena.   | (%wt)        | Type(s) and comment  |
|  |              | rype(s) and comment  |
| 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            |  |
| Higher activity particles  |              |  |
| Soluble solids as bulk chemical compounds                                |              |  |

Hazardous substances / non hazardous pollutants:

Complexing

None expected

|                                       | (%wt) | Type(s) and comment |
|---------------------------------------|-------|---------------------|
| Acrylamide                            |       |                     |
| Benzene                               |       |                     |
| Chlorinated solvents                  |       |                     |
| Formaldehyde                          |       |                     |
| Organometallics                       |       |                     |
| Phenol                                |       |                     |
| Styrene                               |       |                     |
| Tri-butyl phosphate                   |       |                     |
| Other organophosphates                |       |                     |
| Vinyl chloride                        |       |                     |
| Arsenic                               |       |                     |
| Barium                                |       |                     |
| Boron                                 |       |                     |
| Boron (in Boral)                      |       |                     |
| Boron (non-Boral)                     |       |                     |
| 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                            |       |                     |
| agents (%wt): Yes                     |       |                     |
|                                       | (%wt) | Type(s) and comment |
| EDTA                                  |       |                     |
| DPTA                                  |       |                     |
| NTA                                   |       |                     |
| Polycarboxylic acids                  |       |                     |
| Other organic complexants             |       |                     |
| Total complexing agents               | TR    |                     |

Potential for the waste to contain discrete items:

Yes. Large Metal Items (LMIs)/"substantial" thickness items considered

"durable" assumed DIs. NB If recycled then DI Limits n/a

#### TREATMENT, PACKAGING AND DISPOSAL

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

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

Comment on planned treatments:

**Disposal Routes:** 

| Disposal Route   | Stream volume % | Disposal<br>density t/m3 |
|--|-----------------|--------------------------|
| 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 | 100.0           | 1.4                      |

Classification codes for waste expected to be consigned to a landfill facility:

#### Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

| Disposal Route   | Stream volume % |         |         |  |  |
|--|-----------------|---------|---------|--|--|
|  | 2022/23         | 2023/24 | 2024/25 |  |  |
| 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 |                 |         |         |  |  |

### Opportunities for alternative disposal routing:

| will be realised | Baseline Opportunity Management Route Management Route | Stream<br>volume (%) | Estimated Date that Opportunity will be realised | Opportunity<br>Confidence | Comment |
|------------------|--|----------------------|--|---------------------------|---------|
|------------------|--|----------------------|--|---------------------------|---------|

#### **Waste Packaging for Disposal:**

| 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 | 100.0           | 10               | 46                 |

Other information: Data have been presented as though the waste will be in dedicated containers.

However it is likely that this waste will be placed in containers with other LLW.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Inaccessible voidage is not expected.

Waste Characterisation Form (WCH):

The waste meets the LLWR's Waste Acceptance Criteria (WAC).

The waste does not have a current WCH.

Waste consigned for disposal to LLWR in year of generation:

The timing of consignment of the waste for disposal cannot be determined at

present.

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: Activation of the mild steel and its impurities.

Uncertainty: The values quoted were derived by calculation from available material specifications and

are indicative of the activities that are to be expected. The major source of uncertainty is

the impurity levels.

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 specific activities were estimated from neutron activation calculations of the material

and its impurities.

Other information: The activities quoted are those at 85 years after reactor shutdown, i.e. in 2091. There may

be some contamination by Cs137.

#### **WASTE STREAM** Mild Steel (Reactor) LLW 9C314

| Nuclide  |         | Mean radioactivity, TBq/m³ |      |          | Mean radioactivity, TBq/m³ |           |          |      |          |           |
|--|---------|----------------------------|------|----------|----------------------------|-----------|----------|------|----------|-----------|
| H 3  | Nuclida |                            |      |          |                            | Nuclida   |          |      |          | Bands and |
| Be 10  |         | 1.4.2022                   | Code | arisings |                            |           | 1.4.2022 | Code | arisings | Code      |
| C 14   |         |                            |      |          |                            |           |          |      |          | 8         |
| Na 22  |         |                            |      | 4 005 00 |                            |           |          |      |          | 8         |
| A 226 C1 36 A 7 39 A 7 42 A 8 B H 1176 H 1176 H 1176 H 1176 B P 1193 B P 1193 B P 1193 B P 1204 B P 1205 C   |         |                            |      | 1.23E-03 |                            |           |          |      |          | 8         |
| C1 36  |         |                            |      |          |                            |           |          |      |          | 8         |
| Ar 39 Ar 42 K 40 Ca 41 Mn 53 Mn 54 Fe 55 Co 60 Co 60 B.32E-06 CC 2 B.32H0m Ni59 7.16E-05 CC 2 R 22 R 228 R 223 R 228 R 228 R 228 R 228 R 228 R 229 R 28   |         |                            |      |          |                            |           |          |      |          | 8         |
| Ar 42  |         |                            | ÷    | 1.89E-07 |                            |           |          |      |          | 8         |
| K 40   |         |                            |      |          |                            |           |          |      |          | 8         |
| Ca 41  |         |                            |      |          |                            |           |          |      |          | 8         |
| Mn 53 Mn 54 Fe 55  |         |                            |      |          |                            |           |          |      |          | 8         |
| Mn 54  |         |                            |      |          |                            |           |          |      | 2.005.00 | 8         |
| Fe 55 Co 60 Co 60 S 9.92E-06 CC 2 S 9.92E-06 CC 2 S 9.92E-06 CC 2 S 8.92E-06 CC 2 S 9.92E-07 CC 2 S 8 CC 2 S 8 CC 2 CC   |         |                            |      |          |                            |           |          |      | 3.09E-09 | CC 2      |
| Co 60         8.92E-06         CC 2         Bi 20B           Ni 63         7.16E-05         CC 2         Bi 210m           Zn 65         8         Ra 223           Se 79         8         Ra 223           Kr 81         8         Ra 226           Kr 85         Rb 87         Ra 226           SF 90         8         Ra 228           Zr 93         8         Th 227           Xr 93         8         Th 229           Nb 91         8         Th 229           Nb 92         8         Th 229           Nb 93m         8         Th 229           Nb 94         8.57E-08         CC 2         Pa 231           Tc 97         CC 2         Pa 233           Tc 99         3.75E-06         CC 2         Pa 231           Rd 100         Pd 107         Pa 233           Rd 100         Pd 107         Pa 236           Rd 110m         Pa 237         U 236           Gd 113m         Pa 236         U 236           Sh 126         Pu 236         Pu 238           Sh 125         Pu 236         Pu 238           Sh 126         Pu 241         Pu 242 <tr< td=""><td></td><td></td><td></td><td>5 50T 00</td><td></td><td></td><td></td><td></td><td></td><td>8<br/>8</td></tr<>  |         |                            |      | 5 50T 00 |                            |           |          |      |          | 8<br>8    |
| Ni 59 Ni 63 Ni 63 A.04E-03 CC 2 Re 220 Re 220 Re 225 Re 79 Kr 81 Kr 85 Re 81 Kr 85 Re 87 Re 87 Re 88 Re 226 Re 828 Re 227 Zr 93 Nb 91 Nb 92 Nb 93 Nb 93 Re 93 Re 93 Re 106 Re 98 Re 106 Re 107 Re 107 Re 108  |         |                            |      |          |                            |           |          |      |          |           |
| Ni 63  |         |                            |      |          |                            |           |          |      |          | 8         |
| Zn 65       8       Ra 223         Se 79       8       Ra 225         Kr 81       8       Ra 226         Kr 85       8       Ra 228         Rb 87       8       Ac 227         Sr 90       8       Th 227         Zr 93       8       Th 228         Nb 91       8       Th 229         Nb 92       8       Th 229         Nb 94       8.57E-08       CC 2       Th 234         Mo 93       1.63E-05       CC 2       Pa 231         Tc 97       8       Pa 233         Tc 99       3.75E-06       CC 2       U 232         Ru 106       8       U 238         Ru 107       8       U 236         Ag 110m       9E-07       CC 2       U 235         Ag 110m       8       Pu 236         Cd 109       8       U 238         Sh 121m       8       Pu 236         Sh 122       8       Pu 240         Sh 125       8       Pu 241         Sh 126       8       Pu 241         Sh 127       8       Am 241         Te 127m       8       Am 242         Ti 1  |         |                            |      |          |                            |           |          |      |          | 8<br>8    |
| Se 79     8     Ra 225       Kr 81     8     Ra 226       Kr 85     8     Ra 228       Rb 87     8     Ra 227       Sr 90     8     Th 227       Zr 93     8     Th 228       Nb 91     8     Th 229       Nb 93m     8     Th 230       Nb 93m     6     Th 232       Nb 94     8.57E-08     CC 2     Th 234       Mo 93     1.63E-05     CC 2     Pa 231       Tc 99     3.75E-06     CC 2     Pa 233       Tc 99     3.75E-06     CC 2     U 232       Ru 106     8     U 233       Pd 107     9E-07     CC 2     U 236       Ag 110m     9E-07     CC 2     U 236       Cd 113m     8     Np 237       Sn 121m     8     Pu 238       Sn 122m     8     Pu 238       Sn 123     8     Pu 241       Sh 125     8     Pu 241       Sb 125     8     Pu 241       Sb 126     8     Pu 241       Te 125m     8     Am 242       Te 125m     8     Cm 244       Sa 133     8     Cm 245       Sa 133     8     Cm 246       Ca 1  |         |                            |      | 4.04E-03 |                            |           |          |      |          | 8         |
| Kr 81 Kr 85 Kr 85 Kr 85 R8 228 R8 28 R8 228 R8 28 |         |                            |      |          |                            |           |          |      |          | 8         |
| Kr 85       Rb 87       8       Ra 228         Rb 87       8       Ac 227       From 227         Sr 90       8       Th 227       Th 228         Nb 91       8       Th 228       Th 228         Nb 92       8       Th 230       Th 234         Nb 93m       6       Th 234       Th 234         Nb 94       8.57E-08       CC 2       Th 234         Mo 93       1.63E-05       CC 2       Pa 231         Tc 97       8       Pa 233         Tc 99       3.75E-06       CC 2       U 232         Ru 106       8       U 233         Pd 107       8       U 234         Ag 110m       9E-07       CC 2       U 235         Ag 110m       9E-07       CC 2       U 235         Ag 110m       8       U 236         Cd 113m       8       N 237         Sn 12m       8       Pu 238         Sn 12m       8       Pu 239         Sn 12a       8       Pu 240         Sb 12b       8       Pu 241         Sb 12c       8       Pu 241         Sb 12c       8       Pu 242         Tc 13   |         |                            |      |          |                            |           |          |      |          | 8         |
| Rb 87 Sr 90 Sr 90 Rb 91 Nb 91 Nb 92 Nb 92 Nb 94 Rb 93 Th 229 Ru 106 Rb 97 Ru 106 Rb 98 Ru 107 Rb 198 Rb 123 Rb 1198 Rb 123 Rb 124 Rb 123 Rb 124 Rb 125 Rb 125 Rb 125 Rb 125 Rb 126 Rb 126 Rb 127 Rb 128 Rb 128 Rb 128 Rb 128 Rb 129 Rb 128 Rb  |         |                            |      |          |                            |           |          |      |          | 8         |
| Sr 90 Zr 93 Nb 91 Nb 91 Nb 92 Nb 93m Nb 94 8.57E-08 CC 2 Pa 231 Tc 97 Tc 99 Ru 106 Pd 107 Ag 100m QC 109 CC 113m Sn 121m Sn 121m Sn 121m Sn 122 Sn 128 Sn 126 Sb 127 Sb 128 Sb 126 Sb 126 Sb 126 Sb 127 Sb 128 Sb 126 Sb 126 Sb 127 Sb 128 Sb 126 Sb 127 Sb 127 Sb 128 Sb 128 Sb 126 Sb 127 Sb 128 Sb 128 Sb 128 Sb 128 Sb 128 Sb 126 Sb 127 Sb 128 Sb 12 |         |                            |      |          |                            |           |          |      |          | 8         |
| Zr 93  |         |                            |      |          |                            |           |          |      |          | 8         |
| Nb 91 Nb 92 Nb 92 Nb 93 Nb 93 Nb 93 Tc 97 Tc 99 Ru 106 Pd 107 Ag 108m Sn 119m Sn 119m Sn 119m Sn 121m Sn 126 Sb 126 Sc 128 Sc 128 Sc 134 Cc 144 Cc 137 Ba 133 La 137 La 137 La 138 Cc 144 Pm 145 Pm 147 Sm 151 La 137 La 147 Sm 147 Sm 147 Sm 147 Sm 147 Sm 147 Sm 151 Eu 152 In 24   |         |                            |      |          |                            |           |          |      |          | 8         |
| Nb 92 Nb 93m Nb 94   |         |                            |      |          |                            |           |          |      |          | 8         |
| Nb 93m Nb 94 Nb 94 Nb 93 1.63E-05 CC 2 Th 234 Mo 93 Tc 97 Tc 99 Ru 106 Pd 107 Ag 108m Ag 110m Cd 109 Cd 113m Sn 119m Sn 121m Sn 1223 Sn 126 Sb 125 Sb 126 Sb 125 Sb 126 Cs 134 Cc 135 Cc 137 Ba 133 La 137 La 138 Cc 144 Pm 145 Pm 147 Sm 151 Eu 152  Tc 2 Th 232 Th 232 Th 232 Th 234 Th 232 Th 234 Th 235 Th 236 Th  |         |                            |      |          |                            |           |          |      |          | 8         |
| Nb 94 Mo 93 Tc 97 Tc 97 Ru 106 Pd 107 Ag 110m Cd 109 Cd 113m Sh 121m Sh 122m Sh 126 Sb 126 Sb 126 Sb 126 Sb 126 Sb 126 Sb 127 Sb 128 Sb 129 Sb 126 Sb 126 Sb 127 Sb 128 Sb 128 Sb 128 Sb 129 Sb 129 Sb 126 Sb 127 Sb 128 Sb 129 Sb 129 Sb 120 Sb 120 Sb 121 Sb 121 Sb 126 Sb 127 Sb 128 Sb 129 Sb 129 Sb 120 Sb 120 Sb 121 Sb 120 Sb 121 Sb 120 Sb 120 Sb 120 Sb 120 Sb 121 Sb 120 Sb |         |                            |      |          |                            |           |          |      |          | 8         |
| Mo 93  |         |                            |      | 9 57E 09 |                            |           |          |      |          | 8         |
| Tc 97 Tc 99 Ru 106 Ru 107 Ag 108m Ag 110m Cd 109 Cd 113m Sn 123 Sn 121m Sn 123 Sn 126 Sb 126 Sb 126 Te 125m Te 127m It 129 Cs 134 Cs 135 Cs 137 Ba 133 La 137 La 138 Ce 144 Pm 145 Pm 147 Sm 151 La 138 Cc 143 Cc 1 23 Cc 2 U 233 RU 234 U 236 RU 236 RU 238 Pu 236 RD 1235 RD 1236 RD 1241 RD 1239 RD 1241 RD 1241 RD 1241 RD 1241 RD 1242 RD 1242 RD 1242 RD 1242 RD 1242 RD 1242 RD 1244  |         |                            |      |          |                            |           |          |      |          | 8         |
| To 99 Ru 106 Pd 107 Ru 108m Pd 107 Rg 110m Cd 109 Cd 113m Sn 119m Sn 121m Sn 123 Sn 126 Sb 125 Sb 126 Te 125m Te 127m Te 133 Cs 135 Cs 134 Cs 135 Cs 137 Ba 133 La 137 La 138 La 137 La 138 Ce 144 Pm 145 Pm 145 Pm 147 Sm 151 Eu 152 U 232 U 234 U 234 Ru 234 Ru 236 Ru 236 Ru 236 Ru 238 Ru 238 Ru 239 Ru 240 Ru 240 Ru 241 Ru 242 Ru 241 Ru 242 Ru 242 Ru 242 Ru 242 Ru 242 Ru 243 Ru 243 Ru 243 Ru 243 Ru 243 Ru 243 Ru 244 Ru 243 Ru 244 Ru 244 Ru 245 Ru 244 Ru 246 Ru 244 Ru 246 Ru 244 Ru 246 Ru 244 Ru 247 Ru 248 Ru 248 Ru 249 Ru 246 Ru 247 Ru 246 Ru 247 Ru 248 Ru Cf 250 Ru 248 Ru Cf 250 Ru 147 Ru 147 Ru Ru 267 Ru 147 Ru 147 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 147 Ru 147 Ru 147 Ru 148 Ru Cf 250 Ru 148  |         |                            |      | 1.03L-03 |                            |           |          |      |          | 8         |
| Ru 106 Pd 107 Ag 108m Ag 110m Cd 109 Cd 113m Sn 119m Sn 123 Sn 126 Sb 125 Sb 126 Te 125m Te 127m I 129 Cs 134 Cs 135 Cs 137 Cs 137 Ba 133 La 137 La 138 La 137 La 138 Ce 144 Pm 145 Pm 147 Sm 152  V 236 V 238 V 238 V 238 V 238 S Pu 236 S Pu 239 S Pu 239 S Pu 240 S Pu 241 S Pu 242 S Pu 241 S Am 241 S Cm 244 S Cm 244 Cm 244 Cm 245 Cm 244 Cm 246 Cm 244 Cm 246 Cm 246 Cm 248 Cm 250 Cm 147 Cm |         |                            |      | 3 75F-06 |                            |           |          |      |          | 8         |
| Pd 107 Ag 108m Ag 108m Ag 110m B B Cd 109 Cd 109 B Cd 113m B Sn 121m Sn 121m Sn 126 Sb 125 Sb 126 Sb 126 Sb 126 Sc 127m I 129 B Cs 134 Cs 135 Cs 137 Ba 133 La 137 La 138 Ca 144 Pm 145 Pm 147 Pm 148 Pm 149 Pm 147 Pm 146 Pm 147 Pm 146 Pm 147 Pm 148 Pm 149  |         |                            |      | 3.73L-00 |                            |           |          |      |          | 8         |
| Ag 108m  |         |                            |      |          |                            |           |          |      |          | 8         |
| Ag 110m Cd 109 Cd 113m S   |         |                            |      | 9F-07    |                            |           |          |      |          | 8         |
| Cd 109 Cd 113m Sn 119m Sn 12m Sn 12m Sn 12a Sn 126 Sb 125 Sb 126 Te 125m Te 127m Te 127m Te 127m Te 127m Sn 135 Cs 134 Cs 135 Cs 137 Ba 133 La 137 La 138 Ce 144 Pm 145 Pm 145 Pm 147 Sm 147 Sm 151 Eu 152 U 238 Np 237 Pu 236 Pu 238 Pu 239 Sn Pu 240 Sp Pu 240 Sp Pu 240 Sp Pu 241 Sp Pu 242 Sp Pu 241 Sp Pu 242 Sp Pu 243 Sp Pu 244 Sp Pu 244 Sp Pu 244 Sp Pu 244 Sp Pu 245 Sp Pu 246 Sp Pu 240 | - :     | İ                          |      | 3L 07    |                            |           |          |      |          | 8         |
| Cd 113m       8       Np 237         Sn 119m       8       Pu 236         Sn 121m       8       Pu 239         Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       8       Cm 242         Cs 135       6       Cm 243         Cs 137       8       Cm 243         Cs 137       8       Cm 245         Ba 133       8       Cm 246         La 137       8       Cm 248         Ce 144       8       Cf 249         Pm 145       8       Cf 250         Pm 147       8       Cf 252         Sm 151       8       Other a         Other b/g       Other b/g  | -       |                            |      |          |                            |           |          |      |          | 8         |
| Sn 119m       8       Pu 236         Sn 121m       8       Pu 238         Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 243         Cs 134       Cm 242       Cm 243         Cs 135       Cm 244       Cm 243         Cs 137       6       Cm 244         Ba 133       Cm 246       Cm 246         La 137       8       Cm 248         Ce 144       Cf 249       Cf 249         Pm 145       8       Cf 250         Pm 147       8       Cf 251         Sm 151       8       Other a         Eu 152       Other b/g  |         |                            |      |          |                            | Np 237    |          |      |          | 8         |
| Sn 121m       8       Pu 238         Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       8       Cm 242         Cs 135       6       Cm 244         Cs 137       8       Cm 245         Ba 133       8       Cm 246         La 137       8       Cm 248         Ce 144       8       Cf 249         Pm 145       8       Cf 250         Pm 147       8       Cf 251         Sm 147       8       Other a         Sm 151       8       Other b/g   |         |                            |      |          |                            | Pu 236    |          |      |          | 8         |
| Sn 123       8       Pu 239         Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       8       Cm 242         Cs 135       8       Cm 243         Cs 137       8       Cm 244         Ba 133       8       Cm 245         La 137       8       Cm 248         Ce 144       8       Cf 249         Pm 145       8       Cf 250         Pm 147       8       Cf 251         Sm 147       8       Other a         Sm 151       8       Other b/g  |         |                            |      |          |                            | Pu 238    |          |      |          | 8         |
| Sn 126       8       Pu 240         Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       8       Cm 242         Cs 135       6       Cm 243         Cs 137       6       Cm 244         Ba 133       8       Cm 245         La 137       8       Cm 246         La 138       6       Cm 248         Ce 144       8       Cf 249         Pm 145       8       Cf 250         Pm 147       8       Cf 251         Sm 147       8       Other a         Eu 152       8       Other b/g  |         |                            |      |          |                            | Pu 239    |          |      |          | 8         |
| Sb 125       8       Pu 241         Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       8       Cm 242         Cs 135       6       Cm 243         Cs 137       6       Cm 244         Ba 133       8       Cm 245         La 137       8       Cm 246         La 138       6       Cm 248         Ce 144       8       Cf 249         Pm 145       8       Cf 250         Pm 147       8       Cf 251         Sm 147       8       Cf 252         Sm 151       8       Other a         Eu 152       0ther b/g  |         |                            |      |          |                            | Pu 240    |          |      |          | 8         |
| Sb 126       8       Pu 242         Te 125m       8       Am 241         Te 127m       8       Am 242m         I 129       8       Am 243         Cs 134       8       Cm 242         Cs 135       8       Cm 243         Cs 137       6       Cm 244         Ba 133       8       Cm 245         La 137       8       Cm 246         La 138       Cm 248       Cf 249         Ce 144       8       Cf 250         Pm 145       8       Cf 251         Sm 147       8       Cf 252         Sm 151       8       Other a         Eu 152       8       Other b/g   |         |                            |      |          |                            | Pu 241    |          |      |          | 8         |
| Te 125m Te 127m I 129  |         |                            |      |          | 8                          | Pu 242    |          |      |          | 8         |
| Te 127m I 129 B Am 243 Cs 134 Cs 135 Cs 137 Ba 133 La 137 La 138 Ce 144 Pm 145 Pm 147 Sm 147 Sm 151 Eu 152  B Am 242m Am 243 Cm 242 Cm 242 Cm 244 Cm 244 Cm 244 Cm 244 Cm 246 Cm 248 Cm 248 Cf 249 Cf 250 Cf 251 Cf 252 Cf 257 Cf 257 Cf 257 Cf 258 Cf 259 Cf 259 Cf 250 Cf 250 Cf 251 Cf 252 Cf 253 Cf 256 Cf 257 Cf 258 Cf 259 Cf  |         | l                          |      |          |                            | Am 241    |          |      |          | 8         |
| I 129       8       Am 243         Cs 134       8       Cm 242         Cs 135       8       Cm 243         Cs 137       6       Cm 244         Ba 133       8       Cm 245         La 137       8       Cm 246         La 138       Cm 248       Cf 249         Ce 144       8       Cf 250         Pm 145       8       Cf 251         Pm 147       8       Cf 252         Sm 151       8       Other a         Eu 152       8       Other b/g  |         |                            |      |          |                            |           |          |      |          | 8         |
| Cs 134       8       Cm 242         Cs 135       6       Cm 243         Cs 137       6       Cm 244         Ba 133       8       Cm 245         La 137       8       Cm 246         La 138       6       Cm 248         Ce 144       8       Cf 249         Pm 145       8       Cf 250         Pm 147       8       Cf 251         Sm 147       8       Cf 252         Sm 151       8       Other a         Eu 152       8       Other b/g  |         |                            |      |          |                            |           |          |      |          | 8         |
| Cs 135 Cs 137 Ba 133 La 137 La 138 Ce 144 Pm 145 Pm 147 Sm 147 Sm 151 Eu 152  Ra 138 Cm 243 Cm 244 Cm 245 Cm 246 Cm 248 Cm 248 Cf 249 Cf 250 Cf 251 Sm 0ther a Other b/g   |         | l                          |      |          | 8                          |           |          |      |          | 8         |
| Ba 133 La 137 La 138 Ce 144 Pm 145 Pm 147 Sm 147 Sm 151 Eu 152  Ba Cm 245 Cm 246 Cm 248 Cm 248 Cf 249 Cf 250 Cf 250 Cf 251 S Other a Other b/g   |         | l                          |      |          | 8                          |           |          |      |          | 8         |
| La 137 La 138 Ce 144 Pm 145 Pm 147 Sm 147 Sm 151 Eu 152  B   | Cs 137  |                            |      |          | 6                          |           |          |      |          | 8         |
| La 138 Ce 144 Pm 145 Pm 147 Sm 147 Sm 151 Eu 152  B  | Ba 133  |                            |      |          | 8                          |           |          |      |          | 8         |
| Ce 144 Pm 145 Pm 147 Sm 147 Sm 151 Eu 152  Cf 249 Cf 250 Cf 250 Cf 251 S Cf 252 Other a Other b/g  | La 137  | l                          |      |          | 8                          |           |          |      |          | 8         |
| Pm 145 Pm 147 8  | La 138  | l                          |      |          | 8                          |           |          |      |          | 8         |
| Pm 147 Sm 147 Sm 151 Eu 152  Cf 251 Cf 252 Other a Other b/g   |         |                            |      |          | 8                          |           |          |      |          | 8         |
| Sm 147     8     Cf 252       Sm 151     8     Other a       Eu 152     8     Other b/g  | Pm 145  | l                          |      |          | 8                          |           |          |      |          | 8         |
| Sm 151     8     Other a       Eu 152     8     Other b/g  | Pm 147  |                            |      |          | 8                          |           |          |      |          | 8         |
| Eu 152 8 Other b/g   | Sm 147  | l                          |      |          | 8                          |           |          |      |          | 8         |
| 24 102   | Sm 151  |                            |      |          | 8                          |           |          |      |          |           |
|  | Eu 152  | l                          |      |          | 8                          | _         |          |      |          |           |
|  | Eu 154  |                            |      |          | 8                          | Total a   |          |      |          |           |
| Eu 155 8 <b>Total b/g 0 5.37E-03</b>   | Eu 155  | l                          |      |          | 8                          | Total b/g | 0        |      | 5.37E-03 | 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

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
- 7 Present in significant duantities but not determined 8 Not expected to be present in significant quantity