United Nations Scientific Committee
on the Effects of Atomic Radiation

UNSCEAR

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# Methodology for estimating public exposures due to radioactive discharges

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# Background

- UNSCEAR has used a series of methodologies for many years to carry out radiological assessments.
- In 2008 the committee decided to update the methodology and to use it to assess radiation exposures from electricity generation.
- Work took many years with a delay due to the need to concentrate resources on the Fukushima assessment
- Methodology published as part of the UNSCEAR 2016 report.

# Aim of methodology

- To assess individual and collective doses from routine (continuous) discharges to environment.
- Characteristic individuals not representative person
- For use by Committee for worldwide assessments not all situations and uses (not for accidents, risk assessments or regulatory purposes).
- Discharges to atmosphere, rivers, lakes and seas.

# Requirements

- Methodology should be robust, transparent and applicable to different electrical energy sources
- It should build on previous methodologies taking account of updates in the field
- Doses per unit discharge should be provided for key radionuclides
- Although intended for global application regional variations should be considered
- Methodology implemented through Excel workbooks.

# Input and review

- A number of people involved:
  - Consultants
  - Technical review committee
  - UNSCEAR Member states
  - Secretariat
- Workbooks developed by staff from Public Health England in the UK

# Characteristic Individual

- Aim to represent “average” person not “representative person” / “critical group”
- Live 5 km from discharge point for atmospheric discharges
- Live in area around receiving water body for aquatic discharges
- 25 % of food is locally produced

# Radionuclides considered

- 29 important radionuclides for routine discharges from all energy sources
- Global circulation considered for tritium, carbon-14, krypton-85 and iodine-129
- Included progeny notably for radon-222, thorium-232 and uranium-238

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# Endpoints

- Characteristic individual effective dose in the 100$^{th}$ year of discharge at a rate of 1 Bq/s (Sv)
- Collective doses (man Sv) integrated to 100 y from discharge at a rate of 1 Bq/s for 1 year (local and regional)
- For globally circulating radionuclides only collective dose integrated to 100, 500 and 10,000 years.

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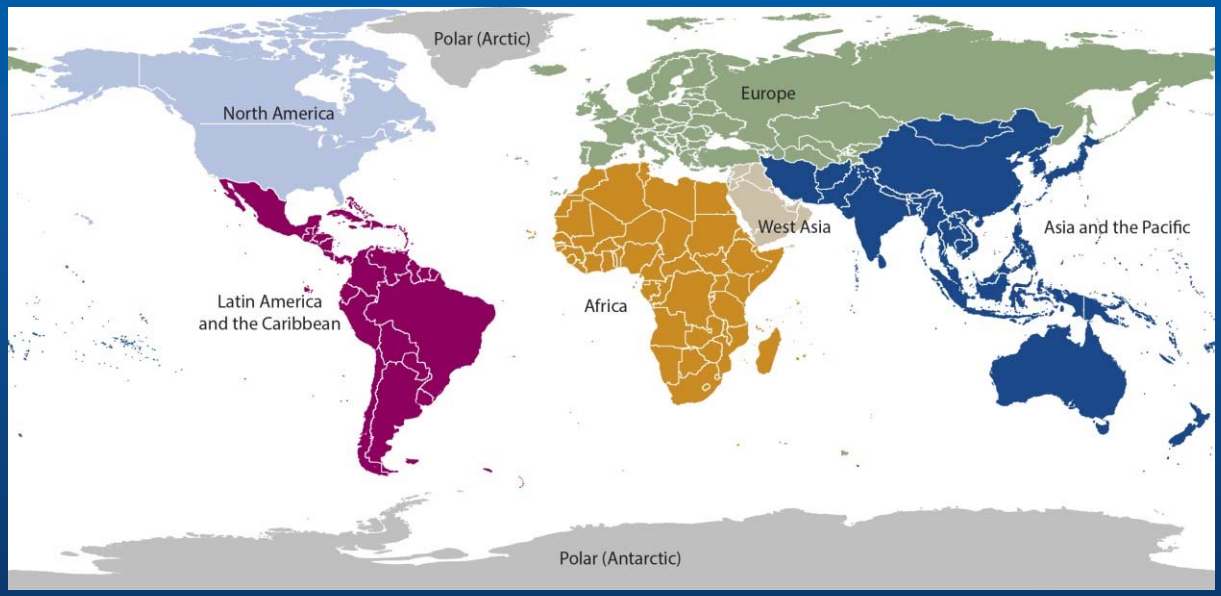
# Exposure pathways

- Discharge to atmosphere:
  - Inhalation
  - External exposure to radionuclides in the cloud and deposited on the ground
  - Ingestion of terrestrial foods
- Discharge to water bodies:
  - Ingestion of aquatic foods and drinking water (freshwater bodies only)
  - External exposure from radionuclides on freshwater and marine sediments
  - Irrigation of terrestrial foods

# UNEP Regions





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# Regional information

- Six regions considered (Africa; Asia and Pacific; Europe; Latin America and Caribbean; North America; West Asia) plus “world average”.
- Population distributions (default plus around nuclear power stations)
- Per-caput consumption rates of terrestrial foods, marine and freshwater foods
- Irrigation rates and transfers

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# Limitations of methodology



- Generic intended for use throughout world not for site specific studies
- Aim to be as realistic as possible – hard to quantify uncertainties.
- Characteristic individual doses dependent on 25% local food assumption
- Collective doses dependent on population distributions
- Many other factors discussed in report.

# Individual dose – marine discharge Sv (1 Bq/s for 100 y)

| Region | Carbon-14 | Polonium-210 |
|---|---|---|
| Africa | 3.2 10*-11 | 1.0 10*-8 |
| Asia and Pacific | 1.0 10*-10 | 1.4 10*-7 |
| Europe | 9.4 10*-11 | 7.5 10*-8 |
| Latin America | 4.5 10*-11 | 4.0 10*-8 |
| North America | 1.1 10*-10 | 1.5 10*-7 |
| West Asia | 2.6 10*-11 | 1.3 10*-8 |
| | | |

# Collective dose atmospheric discharge Caesium-137 man Sv

| Region | Local | Regional |
|---|---|---|
| Africa | 3.5 10*-5 | 1.7 10*-4 |
| Asia and Pacific | 1.4 10*-4 | 6.8 10*-4 |
| Europe | 7.9 10*-5 | 3.8 10*-4 |
| Latin America | 7.6 10*-5 | 3.6 10*-4 |
| North America | 2.2 10*-5 | 1.0 10*-4 |
| West Asia | 5.0 10*-5 | 2.4 10*-4 |
| World average | 8.5 10*-5 | 4.1 10*-4 |

# Ackowledgements


- Current methodology builds on previous work of the Committee and takes account of valuable comments from Member States plus material provided.
- Significant input by previous consultants, PHE staff, other experts and members of the Expert Group as well as from the secretariat.