

**Atmospheric Dispersion Modelling
Liaison Committee**

Annual Report 2001/2002

INCLUDING

**Data assimilation following accidental releases in
rain**

AND

**Workshop on reliability of atmospheric dispersion
models**

PREFACE

In 1977 a meeting of representatives of government departments, utilities and research organisations was held to discuss methods of calculation of atmospheric dispersion for radioactive releases. Those present agreed on the need for a review of recent developments in atmospheric dispersion modelling, and a Working Group was formed. Those present at the meeting formed an informal Steering Committee, that subsequently became the UK Atmospheric Dispersion Modelling Liaison Committee. That Committee operated for a number of years. Members of the Working Group worked voluntarily and produced a series of reports. A workshop on dispersion at low wind speeds was also held, but its proceedings were never published.

The Committee has been reorganised and has adopted terms of reference. The organisations represented on the Committee, and the terms of reference adopted, are given in this report. The organisations represented on the Committee pay a small annual subscription. The money thus raised is used to fund reviews on topics agreed by the Committee, and to support in part its secretariat, provided by NRPB. The new arrangements came into place for the start of the 1995/96 financial year. This report describes the seventh year in which the Committee has operated under the new arrangements, and during which it placed two contracts. These covered a review of possible techniques for data assimilation following accidental releases in wet conditions and a review of models for dispersion in complex terrain. The technical specifications for the contracts are given in this report, and the contract reports are attached as annexes to this report. The Committee also organised a workshop on the needs for, and reliability of, dispersion models for regulatory applications. The papers presented at the workshop are included in this report. The Committee funded ten studies in previous years; they are described in its earlier annual reports.

The Committee intends to place further contracts in future years and would like to hear from those interested in tendering for such contracts. They should contact the Secretary:

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1 ORGANISATIONS REPRESENTED ON THE COMMITTEE

The organisations on the committee during the year covered by this report were:

Amersham plc - now a GE Healthcare company

Atomic Weapons Establishment, Aldermaston

British Nuclear Fuels plc

BNFL Magnox Generation

Defence Science and Technology Laboratory

Department of the Environment Northern Ireland

Environment Agency

Health and Safety Executive

Methodology and Standards Development Unit, Hazardous Installations Directorate

Nuclear Installations Inspectorate

Ministry of Agriculture, Fisheries and Food

Meteorological Office

National Nuclear Corporation

National Radiological Protection Board

Nuclear Department, HMS Sultan

Rolls Royce Power Engineering plc

Scottish Environment Protection Agency

Westlakes Research Institute

The Chairman and Secretary are provided by NRPB.

2 TERMS OF REFERENCE

The terms of reference of the committee during the year covered by this report were:

1 To review current understanding of atmospheric dispersion and related phenomena and to identify suitable models for application primarily in authorisation or licensing, in the context of discharges to atmosphere resulting from nuclear industry activities.

2 The Committee shall consist of representatives of government departments, government agencies and primarily the nuclear industry. Each organisation represented on the Committee shall pay an annual membership fee of £1000.

3 The Committee will consider selected topics. These should be selected following discussion and provisional agreement at meetings of the Committee, followed by confirmation after the meeting. Where possible, it will produce reports describing suitable models for that topic. These will reflect either the views of an Expert Working Group appointed by the Committee or the outcome of a workshop organised on behalf of the Committee. The Working Group will determine who should be invited to speak at workshops, and will subsequently review their outcome and identify suitable models.

4 The money raised from membership fees and registration fees for the workshops will be used to support the Working Group, the drafting of reports, and any other matters which the Committee may decide.

3 WORK FUNDED DURING THE YEAR

3.1 Data assimilation following accidental releases in rain

This topic followed discussions between NRPB and the Committee. The following gives the work proposal drawn up as a result of those discussions.

Weather radar can supply data on water in the atmosphere and likely levels of precipitation. If information is available from sufficient rain gauges this can be converted into a more reliable picture of rainfall. Depending on the information available from the meteorological office an estimate can be made of the level of rainfall at each location, together with an associated measure of the uncertainty in the estimate. The effect of rainfall on levels of enhanced deposition as a function of time and intensity will be researched through the literature. A distinction will be made as far as possible between the amount lost from the plume over a given area and the proportion of that depositing on the soil or being intercepted by plants. This is important when assimilating measurement information and differentiating between short and longer-term hazards.

The assimilation approaches currently being developed rely to a greater or lesser extent on the assumption that the quantities of interest (in this case deposition) vary reasonably smoothly over the area covered by the monitoring. This would not be the case over large areas affected by patchy rain.

The Bayesian assimilation approach under development accepts measurements of quantities of direct interest, such as air concentrations and ground deposits, which are modelled using a simple dispersion model. (A more complex dispersion model could be used which would hopefully have a lower inadequacy term but as explained above the 'final' answer would be the same). This assimilation procedure could be directly adapted (i.e. a much more complex process model used) to account for the effects of rain however because the radar rain data if available is likely to be a rich source of information such a reformulation is unnecessary. A statistical model composed of data from the process model and the correlation effects of the rain can be used to provide the model source for the Bayesian assimilation of the variables of direct interest. The statistical model could be produced within an entirely Bayesian formulation but it is sensible to use the richer spatial modelling heritage of geostatistics.

NRPB will investigate the development of a statistical model representing the merger of a simple dispersion process model and the correlation information available from the rainfall data. The work will be applicable to problems of pollution dispersion under varying rainfall conditions. It will also fit within a Bayesian assimilation scheme for the pollutant data of interest.

There are a number of problems that will need to be tackled if the procedure is to be entirely successful. The most significant of these is the effect of plume depletion on the rain correlated enhanced deposition.

NRPB will investigate methods which could be used to include information on rainfall into data assimilation techniques. The work will cover the following points:

- a Availability of rainfall data
- b Likely spatial and temporal variation in rainfall in different conditions (frontal, showers, etc)
- c Limiting assimilation procedures to areas where the deposition levels are similar, but using information on the air concentration from adjacent areas.

The work will lead to a detailed description of the way in which data assimilation methods could be extended to handle rainfall. It will also lead to guidance on the most appropriate monitoring strategy in the event of rain during an emergency.

The report on this project is published as [NRPB-W34 \(also ADMLC/2001/1\)](#).

3.2 Workshop on reliability of atmospheric dispersion models

The Committee was interested in the reliability of atmospheric dispersion models, and organised a workshop to examine

- d What is required for atmospheric dispersion models in a regulatory context, and what situations are considered in regulatory applications
- e How well models represent current understanding of the physical processes involved.

The papers presented at the workshop are published as [ADMLC/2001/3](#).