Atmospheric Dispersion Modelling Liaison Committee

Annual Report 2004/2005

INCLUDING

Review of guidelines for atmospheric dispersion modelling

Calculation of air concentration indoors

AND

Dispersion following explosions

National Radiological Protection Board
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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 tenth year in which the Committee has operated under the new arrangements, and during which it placed three contracts. These covered a review of the guidelines for atmospheric dispersion modelling prepared by the Royal Meteorological Society, the calculation of air concentration indoors and a review of atmospheric dispersion modelling for releases following explosions. The technical specifications for the contracts are given in this report, and the contract reports are attached as annexes to this report. The Committee funded 21 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

Atomic Weapons Establishment, Aldermaston

British Nuclear Fuels plc

BNFL Magnox Generation

Defence Science and Technology Laboratory

Department for Environment Food and Rural Affairs (DEFRA)

Environment and Heritage Service, Northern Ireland

Environment Agency

Food Standards Agency

Health and Safety Executive

- Methodology and Standards Development Unit, Hazardous Installations Directorate
- Nuclear Installations Inspectorate

Health Protection Agency

Meteorological Office

National Nuclear Corporation

National Radiological Protection Board

Nuclear Department, HMS Sultan

Rolls Royce Naval Marine

Scottish Environment Protection Agency

Shell Global Solutions

Westlakes Research Institute

The Chairman and Secretary are provided by NRPB.

2 TERMS OF REFERENCE

The terms of reference of the committee are:

Areas of technical interest

1. ADMLC's main aim is to review current understanding of atmospheric dispersion and related phenomena for application primarily in authorization or licensing of discharges to atmosphere resulting from industrial, commercial or institutional sites. ADMLC is primarily concerned with dispersion from a particular regulated site or from discrete sources, and will not normally consider work in the following areas: traffic pollution, acid rain and ozone.
2. ADMLC is concerned both with releases under controlled conditions occurring at a constant rate over long periods, and with releases over shorter periods such as accidents or controlled situations where the release rate varies.
3. ADMLC is concerned with modelling dispersion at all scales, including on-site and within buildings.

Organisations and outputs

4. The Committee shall consist of representatives of Government Departments, Government Agencies and organisations with an interest in modelling dispersion of material for the situations identified above. Each organisation represented on the Committee shall pay an annual membership fee.
5. ADMLC believes that it can be most effective by limiting its membership to about 25 organisations. New organisations will only be admitted to membership of ADMLC if the majority of existing members agree to their membership.
6. ADMLC aims to review, collate, interpret and encourage research into applied dispersion modelling problems. It does not endorse particular brands or suppliers of commercial models. However, it is concerned to ensure that users for industrial applications are aware of what is available, how it can be applied to particular problems and of the uncertainties in the results.
7. The Committee will commission work on selected topics. These should be selected following discussion and provisional agreement at meetings of the Committee, followed by confirmation after the meeting. It will produce reports describing current knowledge on the topics. These may be reports from contractors chosen by the committee or may be based on the outcome of conferences or workshops organised on behalf of the committee. The money raised from membership fees will be used to fund contractors, organise workshops and report on their outcome, and any other matters which the Committee may decide.

3 WORK FUNDED DURING THE YEAR

3.1 Review of dispersion modelling guidelines

Discussion in ADMLC identified lack of appropriate guidance/training in Atmospheric Dispersion Modelling as a root cause of inadequacy in some applications of atmospheric dispersion models. ADMLC considers that publication of up to date guidance on Dispersion Modelling may be one way to facilitate possible improvement in applications although this cannot be a replacement for proper training.

The work will include

1. Specify the scope and content of the guidelines.

   Draw up a contents list for the revised guidelines. This will be section headings plus a short paragraph on what each section will contain.

2. Obtain comments on the document from step 1.

   Consult relevant organisations (e.g. ADMLC, DMUG, IAQM, RMS) to gain endorsement for and improve upon the proposed scope and content of the guidelines. This will seek comments from the organisations represented on those "committees", rather than the views of the "committees" themselves. The document will also be placed on the ADMLC web site (with links from IAQM, NSCA web sites?), so that comments can be obtained from other people.

3. Produce a draft of the final guidelines

   Establish a "Working Group" to review the comments, and produce the first draft of the final guidance.

4. Obtain comments on this draft as in step 2.

   Collate the comments received.

5. Prepare the final version of the guidelines

   The "Working Group" reviews the comments from step 4, and prepares the final version of the document.

6. Publish the final guidelines

The report on this work is published as ADMLC/2004/1.

3.2 Air Concentration in Buildings from Sources Outdoors

Previous studies undertaken for ADMLC have examined concentrations outdoors from sources outdoors. The Committee is now interested in models for calculating concentrations inside a building from material in a cloud outside the building, or of reviewing published information on the ratio of indoor and outdoor concentrations. A simple model for this (see page 96 of http://www.admlc.org.uk/ar96-97(new).htm), leads to the conclusion that the concentration inside buildings is about half or less of that outside buildings. Some reviews suggest that indoor and outdoor concentrations are similar.

The committee is interested in work on the following aspects of the problem:

a Modelling the air concentration indoors from a short release, including the time variation of the indoor concentration as it builds up and then reduces. This should also provide typical values for the parameters of the model reflecting UK building types.

b The comparative indoor concentrations of aerosols (particularly PM_{10} and $PM_{2.5}$) and reactive and inert gaseous pollutants.

c The effect of atmospheric conditions on the concentrations indoors.

d The equilibrium ratio of indoor and outdoor concentration for materials which are present in outdoor air at a reasonably constant rate over an extended period of time.

The report on this work is published as ADMLC/2004/2

3.3 Aspects of Dispersion following an Explosive Release

ADMLC is interested in reviewing models for predicting the dispersion of toxic and flammable gases and particulates following explosive releases and very short duration catastrophic events

The main aim is to produce an overview of current knowledge describing the distribution of material that is produced immediately after the explosion, and how the size and distribution of material within that plume might depend on the characteristics of the event. Thus the emphasis is on providing a source term for use with a standard dispersion model. The review needs to identify what appropriate processes need to be considered when modelling the subsequent dispersion, but not to explore that dispersion in depth.

The scope of the review could include

e high explosive combined with radioactive material, as in terrorist events,

f high explosive combined with toxic material as in terrorist events.

g releases from terrorist attacks on bulk shipments, (e.g. LNG)

h releases from terrorist attacks on road/train shipments of toxics

i releases from catastrophic failure of pressurised storage vessels

j releases involving fast chemical reactions such as the sudden addition of water to a spill of a water reactive material generating a toxic vapour.

The review should cover the following aspects of the problem:

a The size and height of the initial plume produced by the explosion, as functions of the explosive yield, including penetration of the boundary layer.

b The distribution of material within the plume formed immediately after the explosive release, and the size distribution of aerosols, as a function of explosive yield.

c The most appropriate way of describing the processes immediately after the initiating event including the dispersion and deposition of the resulting plume, and a review of models for such calculations. This could include consideration of the buoyancy of the initial cloud and the deposition of large particles released, together with any other features that are relevant.

d Comments on the extent to which the subsequent dispersion could be predicted using simple Gaussian plume models, or how such models could be extended for this application.

The report on this work is published as ADMLC/2004/3