ANNEX B: SUMMARIES OF THE PILOT STUDIES SURVEYED

B. 1 Disaster Preparedness Plans Responding to Chemical Accidents (Health and Medical Aspects)

Duration: 1988 to 1994
Pilot Study Contact: Mr E Kent Gray, USA

Objectives

- To identify the health and medical issues to be addressed in chemical emergency preparedness and response activities.

Pilot Study Overview

This Pilot Study provided a forum for international disaster planners and associated health and response personnel to meet and discuss ideas on public health and response issues related to chemical accidents. Meetings and workshops were held in key cities of NATO countries.

The Pilot Study reported that many chemicals represent a threat to our safety when they are used inappropriately or released in an uncontrolled manner. The exposure of workers and the general public to hazardous chemicals can lead to health impacts ranging from mild eye irritations to death. Long-term health problems can also occur. The potential impact on the environment and economy is also a major concern associated with the release of hazardous substances.

In view of the limited availability of medical treatment for chemical exposures and the psychological problems that can occur, prevention is the key to success. Use of proper engineering practices, containment, training of workers, proper maintenance, proper transportation, land use planning, and response training are all factors in the prevention, or minimisation, of chemical exposure. Successful prevention plans will require harmonisation of reporting systems, response activities, terminology, equipment, and most importantly of all, cooperation among all responders at the local, national, and international level.

There is a general lack of involvement of health professionals in addressing preparedness and response activities. Public health, emergency rescue and hospital staff are frequently insufficiently trained and equipped to respond to chemical releases. Hospitals are not routinely prepared to decontaminate chemical casualties, administer appropriate treatment or collect information needed for proper documentation of the event.

The Pilot Study Report provides summation chapters for Health and Medical Response Preparedness for Chemical Releases, Health Hazard Assessment, Environmental Health Considerations, Medical Management of Chemical Disasters, and An Epidemiological Approach to the Management of Chemical Incidents. The Report aims to provide a common framework for a stronger influence of healthcare systems on the preparedness for, and response to, hazardous substances release.

Conclusions of the Pilot Study

The Pilot Study arrived at the following conclusions relative to the assigned objectives: -

- Planning and legislation generally excludes small events, small quantities and small manufacturing facilities. This may account for a significant amount of under reporting.
- A centralised information and scientific reporting system that allows adequate documentation of health impacts does not exist for chemical incidents. There is no standard international definition of a chemical incident. Current reporting thresholds can give the impression that the frequency and impact of releases are low. The reporting systems that do exist are generally incomplete, lack information, and tend to preclude detailed analysis necessary for planning healthcare.
- Risk assessment plays an essential role in planning for chemical releases. Such assessments should be based on human rather than animal data and should not use lethality as the sole action level when dealing with civilian populations. Risk assessment methodologies tend to vary considerably. The models may be unreliable in real incidents due to the topography, release scenario, demographics, and health indicators chosen.
- National governments should be encouraged to support local efforts in the prevention of releases and the development of response teams.
- Mutual aid agreements between countries, regions, and communities should be encouraged as they enhance the resources available to address a chemical release.
- There is a lack of recognition by response organisations of the value and utility that the involvement of health professionals can have in chemical incidents. Medical teams must be trained to go "on scene" to address casualties and assess any health and safety problems. Planning for response to a release must include the individuals and organisations that will be involved in the response.
- Health organisations do not understand their role in chemical incidents or the response process and the role of other organisations. This is usually due to a lack of resources and training. The role of health workers addressing the population and media is also ill defined.
- Due to the advanced training of health personnel it is wrongly assumed they are prepared to handle the health issues following a chemical release.
- Non health planners must be aware that there may be no physical injuries following a chemical incident and that the impact of a chemical release on health may only be exhibited after the event in the form of subtle symptoms or disease manifestations.
- Legislative mandates for response to chemical incidents are often based on the type, or location, of the release without regard to other organisations and their concerns which would be impinged on.
- Psychological issues may override actual physical casualties. It must be anticipated that psychological stress will occur. This is a scenario rarely accounted for in planning activities.
- The scientific data regarding the health impact of exposure to chemicals is incomplete. Interpretation of available data and informed input into the decisions regarding the potential health threat posed by a substance is necessary. Input from both health and environmental dispersal experts should reduce the risk of planning groups taking decisions that could be contra productive.
- Models and systems used to predict the dispersion of contaminants need to be verified, as the Pilot Study found big differences which could cause confusion in planning responses.
- Health personnel should take an active role in increasing community awareness of chemicals found in, and transported through, the community.

- Remediation to return sites and individuals to desirable post-incident state should be included in the planning efforts of the community.
- A resource for information on medical effects and treatment advice needs to be available on a 24 hour a day basis, possibly as part of another existing information centre. A list of other resources should be developed and verified periodically.
- Prevention of release should be stressed in all planning efforts.
- One uniform plan for response in all countries should not be prepared since the national and local resources and situations could not be represented.

Recommendations for future NATO involvement, National Policy, Research and Training were also provided in the Pilot Study Report.

Outputs/Information Available

- CCMS "Blue Book Series" – Report number 198
- Plenum Press – Volume 14

Further References

CCMS Report (1995) Disaster Preparedness Plans Responding to Chemical Accidents (Health and Medical Aspects). Document AC/274-D/336

NATO CCMS (1995) Disaster Preparedness Plans Responding to Chemical Accidents. Brussels, Ministere de la Sante Publique.

B.2 Management of Industrial Toxic Wastes and Substances Research

Duration: 1992 to 1998
Pilot Study Director: Professor Karayannis, Greece

Objectives

- Mapping of the problems regarding toxic wastes in the participating countries.
- Exchange of scientific knowledge regarding monitoring, reduction, disposal and management of toxic wastes.
- Exchange and transfer of technical knowledge and know-how concerning remediation of stressed or degraded ecosystems.
- Discussion of legislation matters for disposal and management of toxic wastes.
- Examination of international guidelines for the acceptable concentration levels of toxic substances.
- Consideration of the idea to create a European network for future collaboration on the above subjects.

Pilot Study Overview

Three meetings were organised during the period of the Pilot Study, all of which took place in Greece. The first meeting was titled "Treatment of Industrial Wastes" and was held to discuss the perspectives and general direction of the Pilot Study.

The second meeting was titled "Present Status of Pollution from Wastes - Legislation". This consisted of talks on various aspects of management of toxic waste in Europe by participants from Turkey, Czech Republic, Greece, Poland, Portugal, Romania, UK and Belarus. In conclusion of the meeting, the Pilot Study Director invited participants to outline what they considered were the most critical problems concerning toxic wastes in their countries. Responses were received from Romania, Czech Republic, Italy/UK, Turkey, Greece, Belarus and Poland.

The final gathering took the form of a workshop titled "Incinerators: Yes or No – Experience and Future Perspectives". This brought together experts interested in the use of waste incinerators. It also provided an opportunity for general discussion on the future management of industrial and domestic toxic wastes.

The Pilot Study included talks and discussions related to a wide range of strategies, treatments, reviews, research and case studies etc. related to toxic waste and substances management. The participants of the Pilot Study submitted fifteen reports in total.

Conclusions of the Pilot Study

The conclusions of the Pilot Study can be outlined as follows: -

- East European countries showed significant interest for active participation in the work of the Pilot Study. Albania, Belarus, Czech Republic, Poland and Romania expressed an interest to present the problems of their countries regarding environmental pollution and management of toxic wastes and seek guidance from the developed European countries that participated in the meetings.

- There is a lack of toxic wastes legislation in East European countries which impedes their efforts in controlling toxic waste problems.
- The legislation on toxic wastes of European Union (EU) countries is not yet harmonised and adjusted to the EU General Directives.
- The radioactive pollution that originated from the Chernobyl accident is a serious problem for Belarus.
- The Czech Republic and Poland have big pollution problems arising from the mining of toxic metals.
- Albania and Romania have serious problems of pollution related to the pumping of petrol oil and the petrol oil refineries.
- Greece has problems with the efficient management, collection and land filling of civil wastes. There is also a lack of legislation regarding toxic wastes and protection of tourist areas from petroleum pollution.
- Turkey has problems from the overuse of pesticides, pollution from petrochemical industries, tanning industries and lack of legislation.
- Cases of water pollution from phenol compounds, toxic metals, pesticides and Polycyclic Aromatic Hydrocarbons (PAH) were reported by many of the participants.
- All the participating countries expressed their willingness to continue exchanging information regarding management of toxic wastes and to collaborate in the future by participating in research projects on this area.

The Pilot Study also made various recommendations concerning future NATO involvement and research in the subject area, particularly in respect of assistance to East European countries.

Outputs/Information Available

No Final Report has yet been produced, though participants of the Pilot Study submitted various individual reports (it has not been possible to substantiate their availability at the current time): -

- J Metrega (Poland) – Industrial Toxic Wastes and Environmental Situation in Poland
- A Taylor (UK) – Bioremediation: An Innovative Solution for the Remediation of Hydrocarbon Contamination in Soils, Groundwater and Marine Environments.
- K Curi (Turkey) – Hazardous Waste Management in Turkey.
- R Chrzaszoz, J Pielishowaski and A Grochowalski (Poland) – PCDD/F Mass Concentration in Bottom Ash from an Incineration of Medical Wastes in Poland.
- T Pajak (Poland) – Management of Solid Municipal Waste in Poland: the Present and Future Perspectives of Applied Thermal Waste Utilisation.
- L Stefanescu (Romania) – Pilot Study for Liquid Combustible Waste Incineration in Existing Industrial Furnaces.
- E Zira (Greece) – Legislation for Solid and Liquid Wastes in Greece and Europe.
- A Cullaj (Albania) – Information About the Situation of Solid Wastes in Albania.
- H J Collins (Germany) – Mechanical and Biological Treatment of Wastes as the First Step in View of Proper Waste Management.
- N Katsaros (Greece) – A General Review of Municipal and Industrial Wastes in Greece.
- A Semeshko (Belarus) – Waste Problems in Belarus
- A M Anselmo (Portugal) – Toxic and Hazardous Waste Production in Portugal.
- C D Stalikas (Greece) – Hazardous Waste Management in Greece.

- C D Stalikas & M I Karayannis (Greece) – Toxic Waste and Environmental Situation in Greece. Recent Efforts for Efficient Management (appeared in Fresenius Environmental Bulletin Journal).
- J Van der Waal (Netherlands) – Experiences on Incineration of Wastes in the Netherlands.

Further References

CCMS Report (1999) Management of Industrial Toxic Wastes and Substances Research. Document EAPC(CCMS)D(99)6

B.3 Deprived Urban Areas

Duration: 1992 to 1996
Pilot Study Director: J Donzelot, France

Objectives

- To assess the scale of deprived urban areas, their distribution according to country and, within each country at various levels of urban fabric (old, abandoned city centres; peripheral low-cost housing areas; declining industry; self-build housing areas, etc.).
- To make a diagnosis of the phenomenon; does it represent one and the same trend at different stages of advancement depending on the country, or is it the product of many processes whose significance varies too widely for a single explanation.
- To observe the range of political responses to this issue.
- To evaluate policies to combat urban social decline; by comparing these policies, can a finding be extracted on which recommendations can be based?

Pilot Study Overview

The Pilot Study was completed in two phases. During the first phase, a common framework for analysis was prepared. The second phase provided a seminar opportunity for experts from each country to present their answers to the questions raised by the common framework, and to express their views on the reports of earlier seminar sessions. The situations in Belgium, Italy, Portugal, UK, Turkey, Germany, The Netherlands, Switzerland, Spain, Greece, Canada, USA and France were examined.

Part 1 of the Final Report provides a description and diagnosis of the deprived urban areas and analyses the relationship this has with what is known as the new social question or the question of exclusion. Part 2 highlights the emergence of a new type of deprived area social policy that sets out to deal with "situations", rather than categories of individuals, as was the case with the traditional assistance policies or insurance-type social protection policies. The description and diagnosis part considers three phenomena that may lead to the constitution of a deprived urban area in developed countries: -

- Settlement of first-generation immigrants in underdeveloped urban areas or self-build areas.
- The break-up of former working class areas in cities with a long industrial tradition that have been hard hit by restructuring of the production system.
- Regulation of outcasts or those sidelined by economic developments to certain urban areas that have been left behind by current housing and living standards.

The common thread of all three phenomena is a societal crisis that affects vulnerable socio-economic groups such as the unemployed, those without job security, single-parent families, and immigrants. The origin of the societal crisis can be traced to economic globalisation, changes in the production system as a result of technological advances, a breakdown in wage patterns, and a change in family structures. All of these can affect social cohesion.

The degree of state intervention is the main factor determining the form of social cohesion experienced in urban areas. There is a correlation between the degree of welfare-state provision and the attention that societal crisis receives. A less significant factor determining social cohesion is whether societies are characterised as nations made up of citizens or nations

made up of communities. The Pilot Study also considered the risk to social cohesion through the compartmentalisation of an urban community in response to rising insecurity.

Part 2 of the Study considers the different policies adopted by different countries in respect of deprived urban areas. Approaches identified include: -

- An emphasis on the criticism of welfare through the belief that it perpetuates the problems it is intended to solve.
- An emphasis on the community approach and on the need to combat self-enclosure of the population by its self-affirmation.
- Emphasis on assistance in combating the deprivation and vulnerability of deprived groups by central encouragement through positive discrimination and contractual support for them.

In practice, all three ingredients are found in differing proportions in the deprived urban policies of most countries. From this, the Pilot Study constructed a general model, a "standard ideal" which is not found in its pure state anywhere but has been partly created everywhere. The general model has 3 main characteristics: -

- There is an attempt to replace the traditional assistance-orientated and allowance-orientated social provision by a form of action dealing with the "situation" and not specific categories of the population.
- An emphasis is placed on mobilisation of the population groups concerned through the advocacy of self-affirmation in order to counter self-enclosure of the groups in their district.
- Implementation of policies to galvanise the deprived areas, in that the imbalance from which they suffer in terms of investment resources is offset by positive discrimination policies.

Conclusions of the Pilot Study

The Pilot Study put forward the following recommendations for conclusion of the research: -

- The effectiveness of deprived urban area policies can only be tested by means of building up a comprehensive assessment of the situation. Experts involved in the Pilot Study all indicated their desire to participate in such a project, effectively forming a second phase to the study. A provisional timetable and structure was suggested, along with the title "The Questioning of the Social Compact by Deprived Urban Areas: Analyses and the Response of the Authorities".
- Further consideration of issues highlighted in the initial investigations, but not proposed for inclusion in a second phase is desirable. Such issues are mainly related to gaining a better understanding of the social challenges manifested in deprived urban areas. This includes trends in migration, underground economic networks, the rise in insecurity and urban violence, etc.

Output/Information Available

- Deprived Urban Areas – CCMS "Blue Book" Series – Publication number 215
- Les Zones Urbaines Defavorisees – (French Version) – Publication number 216

Further References

CCMS Report (1997) Deprived Urban Areas. Document NACC/PFP(CCMS)D(97)1
Donzelot J and Jaillet M C (ed.s) (1997). Deprived Urban Areas. Paris, Plan Urbain.

B.4 Pollution Prevention Strategies for Sustainable Development

Duration: 1990 to 1995
Pilot Study Director: Mr H M Freeman, USA

Objectives

- To establish an international network of individuals and agencies engaged in the development of pollution prevention and sustainable development initiatives.
- To provide a forum to disseminate the results of pollution prevention research and identify those programmes that facilitates the adoption of such technologies and practices.
- To survey current regulatory and market approaches and government and non-government programmes in order to identify effective mechanisms in each country, which encourage pollution prevention.
- To develop mechanisms for individuals working in the field of pollution prevention to broaden their understanding of the subject by working in rotational assignments with agencies in participating countries.
- To support the presentation of educational seminars and training workshops in various countries.
- To provide a focus for exchanging information on new pollution prevention options to individuals and agencies with non-NATO countries.

Overview of Pilot Study

Following an Organisational Meeting in USA and a Programme Review Meeting in Greece, a total of five Workshops took place during the course of the Pilot Study. They were held in Turkey, Italy, Austria, USA and Hungary respectively. The main purpose of the workshops was to facilitate the sharing of information on technologies and techniques available for reducing pollution, and to consider various national and international programmes that encourage pollution prevention.

The gathering in Hungary was a NATO Advanced Research Workshop made possible by a grant provided by the NATO Science Programme. It explored a number of issues related to sustainable development.

Conclusions of the Pilot Study

The major focus of the Pilot Study was the support of presentations of educational seminars and training workshops in various countries. The Pilot Study was considered particularly effective in raising the profile of sustainable development and pollution prevention issues within the countries where workshops were held and with the people who participated.

The NATO Advanced Research Workshop was considered the most effective outcome of the Pilot Study, in that it had national impact beyond NATO countries.

It was anticipated that the network of participants established by the Pilot Study would continue to function after the Study's termination.

Output/Information Available

It was claimed no Final Report was produced "due to the nature of the subject". Proceedings were produced and distributed to participants for at least two of the workshops, though copies are not held by CCMS. However, the following publications were outputs of the Pilot Study: -

- International Directory of Pollution Prevention Professionals (1992)
- Pollution Prevention Strategies for Sustainable Development Newsletters (Volume 1 1991 and Volume 2 1992)
- Cleaner Technologies & Cleaner Products for Sustainable Development – NATO Advanced Study Institute (ASI) Series – ISBN Number: 3-540-59126-5

References

CCMS Report (1995) Pollution Prevention Strategies for Sustainable Development. Document AC/274-D/346

NATO (1995) Cleaner Technologies & Cleaner Products for Sustainable Development – NATO Advanced Study Institute (ASI) Series – ISBN Number: 3-540-59126-5

B.5 The Protection of Astronomical and Geophysical Sites

Duration: 1985 to 1991
Pilot Study Director: J Kovalevsky, France

Objectives

- To identify the causes of interference which could hamper the use of existing or planned observatory instruments.
- To establish tolerable thresholds and define methods of reducing interference to an acceptable level.
- To formulate proposals to protect scientific observatories.
- To give examples of laws enabling observatories to be protected.

Pilot Study Overview

This Pilot Study addressed the problem of protecting astronomical and geophysical observatory sites against the long-standing problem of environmental pollution.

Ground-based and optical astronomy relies on the detection and interpretation of electromagnetic radiation emitted by celestial bodies. Damage sustained by such radiation is also damage to the scientific information they carry. The damage can be caused naturally by the atmosphere, and by non-celestial light or radio waves entering the telescopes. Whilst astronomers have learned, and continue to do so, how to cope with damage caused by the atmosphere, artificial emissions cause a real problem. This is because artificial emissions have the same characteristics as natural emissions. The two can mix and there is generally no means, even in theory, to separate them.

Geophysics is used to monitor the Earth's crust, oceans and atmosphere directly. Whilst this quite often necessitates the use of remote sensing techniques, the difference to astronomy is that the objects of geophysical study are made of matter and are often opaque. This enables geophysics to use a more diversified range of tools than astronomy. In addition to light and radio waves, geophysics also uses chemical analysis to study the atmosphere and oceans, acoustic waves and mechanical vibrations to study the Earth via seismology, and magnetometers and gravimeters to measure other parameters of the Earth's interior. As in the case for astronomers, geophysicists also need to protect their instrumentation from spurious interference that can affect the signal of interest.

The Pilot Study identified the following artificial nuisances and considered proposals to reduce or eliminate their effect: -

- Optical Astronomy: The atmosphere diffuses light produced by outdoor lighting leading to two main adverse effects. Firstly, the contrast between the sky background and the star light is diminished, meaning the faintest stars are no longer detectable. And secondly, artificial sky glow can alter the features of the light spectrums emitted by a celestial body (Figure B.1). The Pilot Study made a number of suggestions for reducing sky glow through the best possible professional lighting design. Many of the solutions also have the wider benefit of maximising energy savings. The relative merits of four principal types of lamps used for public lighting, in terms of their interference to astronomy, were also assessed.

- Radio Astronomy: This requires spectral bands that are free from earth-based emissions. The main causes of interference are radio-emitters, fixed and mobile radio telecommunications, radar and various radio sounders, satellite, aircraft and balloon telemetry or tele-transmissions, and television emitters. Other unintentional signals exist. All interference can be detected directly, or through the side-lobes of radio telescopes. The Pilot Study highlights the importance of the World Administrative Radio Conference (WARC) convened by the International Telecommunications Union. The origin of nuisances and levels of protection offered by WARC are considered in respect of exclusive allocations, sharing bands, other bands, and uncontrolled non-intentional emissions.

Figure B.1 - Satellite View of Light Pollution in South West Europe at Night (from Kovalevsky 1992)

- Millimetre Wavelength Astronomy: The situation is similar to radio astronomy, though the spectrum is not as crowded yet. Suggestions for management of the millimetre wavelength electromagnetic spectrum are similar to those put forward for radio waves.
- Geophysics techniques: Geophysical observations based on electromagnetic radiation require a non-illuminated clear sky. Sounding techniques, as for radio astronomy, require the absence of radio interference. Heat production can cause image degradation for optical observatories. High voltage electrical equipment can interfere with magnetic field measurements. Natural seismic activity can be disturbed by locally produced vibrations from vehicles and heavy plant and machinery. High precision gravimeters are affected by very faint vibrations. The local presence of industrial smoke and vehicular movement can interfere with geophysical readings of the chemical composition of the atmosphere. The Pilot Study offered suggestions for reducing the nuisances for all these categories of geophysical readings.
- Satellites and Aircraft: Satellites are so numerous that the chances of recording an undisturbed image of the sky are very small. In the worst scenario, a bright satellite passing the view of a telescope many damage or destroy the receiver. Space objects increase the natural sky glow, thus diminishing the starlight. The vapour trails of aeroplanes and the brightness of their position lamps during the night can have the same negative effects as satellites. The Pilot Study suggests no space object should be launched with an apparent

magnitude at perigee -3 or brighter. Reduction of nuisances caused by aircraft need to be discussed locally.

The CCMS Report takes the form of a general introduction that provides a broad overview of the whole study, and 6 chapters dealing with each technical aspect linked with the Pilot Study:

- Light Pollution
- Radio interference
- Millimetre Band Radio Astronomy
- Pollution of Geophysical Sites
- Satellites, Space Debris, Aircraft and Astronomy
- Protection of Observatories: the Legal Avenues

Conclusions of the Pilot Study

Conclusions of the Pilot Study are presented on the basis of interference on worldwide, medium and local scales.

Worldwide interference needs to be dealt with by worldwide intergovernmental organisations. For radio astronomy in all wavelengths, the principal conclusions are: -

- There are tremendous pressures on the radio spectrum, which originate in services and technologies.
- It is impossible to accommodate all wishes.
- The passive services, such as radio astronomy, are highly vulnerable services and have great difficulties in sharing with active services.
- Radio astronomical observatories are suffering from harmful interference during a considerable fraction of their time of operation, often from space-borne transmitters.

The recommendations following on are: 1) Some bands of interest to radio astronomers and other passive scientific services must be left completely radio quiet, 2) The passive services should not have to share with mobile, airborne or space borne active services, 3) Organisations that manage the spectrum should realise that the mere fact that radio astronomy does not cause interference does not mean that radio astronomy is not there. It works in "silence", and 4) Many new protected bands should be allocated to microwave astronomy and geophysics.

Medium scale interference can include sources of nuisance originating hundreds of kilometres away from major observatories. Such interference needs to be addressed by authorities that have the power to legislate above local bodies. Many of the technical solutions suggested by the Pilot Study would be appropriate for reducing medium scale interference.

National legislation is a strong recommendation of the Pilot Study in terms of local solutions for nuisances. This would need to place an emphasis on global and scientific need over local interests. The framework suggested includes:

- For each observatory site in astronomy and geophysics, a protection plan is established, after a public enquiry, by a commission including representatives of the concerned institute, local authorities, experts and national authorities (national research councils or equivalent bodies).

- The same procedure is applied to modify an existing protection plan.
- In some cases, if the protection plan encroaches someone's rights, compensation should be paid by the Institute in an amount decided by common agreement or by judgement.
- Penalties are laid down against violation of the protection plan.
- Local authorities are bound to enforce the plan.
- Constructions, industrial installations, etc. established after the protection plan comes into effect must abide by it without any compensation.

Outputs/Information Available

- CCMS "Blue Book" Series – Report number 189
- Hardback Editions Frontieres version – ISBN No: 2-86332-109-9
  (B.P. 33, 91192 Gif-sur-Yvette, Cedex, France).
- Proceedings of the 1991 International Astronomical Union's Colloquium on "Light Pollution, Radio Interference & Space Debris". Published in the Astronomical Society of Pacific Conference Series.

Further References

CCMS Report (1991) Protection of Astronomical and Geophysical Sites Document AC/274-D/299

Kovalevsky J (ed.) (1992). The Protection of Astronomical & Geophysical Sites. Grasse, Editions Frontieres.

B.6 Pilot Study on Air Pollution: International Technical Meetings (ITM) on Air Pollution Modelling and its Application

Duration: 1969 to ongoing
Pilot Study Director: Various – Current Chairman of ITM: Dr S E Gryning, Denmark

Objectives

Air pollution is recognised as one of the most significant environmental problems facing the Industrialised Society. The objectives of air pollution Pilot Studies have evolved over time. The main activity currently is the organisation of periodic conferences known as International Technical Meetings (ITM) dealing with air pollution modelling and its application. The aim of the ITM can be outlined as follows: -

- To provide a forum for the interchange of technical data and scientific research on air pollution.

Pilot Study Overview

The first completed Pilot Study was simply titled "Air Pollution" (1970 to 1974). It focused mainly on air quality assessment. 19 technical reports were produced, and in addition to air quality assessment, the subjects of air pollution modelling, air quality criteria, pollutant control techniques, and cleaner vehicular engines were also considered.

The Pilot Study for "Air Pollution Assessment Methodology and Modelling" (1975 to 1979) focused mainly on comprehensive air quality management systems and air quality modelling. It was understood by the Pilot Study group that although efforts were being made to reduce emissions from particular sources, additional efforts were urgently needed on national, regional and local scales.

The third Pilot Study in the series was titled "Air Pollution Control Strategies and Impact Modelling" (1979 to 1984). It concentrated on the reduction of heavy metal emissions from stationary sources, air quality predictions, and environmental impacts. Detailed comparisons of air pollution transport models were performed.

The topic of air quality modelling emerged as an important subject during the early 1970's. When the Pilot Study ended in 1984, it was unanimously agreed that scientific meetings should be continued. As a result, CCMS decided to organise International Technical Meetings (ITM) on Air Pollution Modelling and its Application. Since then, 24 CCMS ITMs have been organised. The most recent was held in Boulder, Colorado, USA. It included 80 technical papers and 45 poster presentations, and was attended by 135 participants representing 30 countries from NATO Alliance, NATO Cooperative Partner, and non-NATO countries.

There are a large number of abstracts submitted for the conferences, though it is usually only possible to accommodate time for about half of them. Attendance is limited to about 150 participants to ensure that presentations and discussions are of high quality.

ITMs provide a forum not just for models developed by national environmental agencies for regulatory purposes, but also for fundamental studies carried out at universities and research centres.

CCMS traditionally funds the ITM participation of a number of PhD students and scientists entitled to funding from the CCMS Study Visit Programme. CCMS also funds three to four keynote speakers. Generally it is considered an honour to deliver a keynote talk at an ITM.

Conclusions of the Pilot Study

The achievements of the early Pilot Studies, in addition to being the inspiration behind the development of ITMs, can be outlined as follows: -

Air Pollution Pilot Study:

- Led to the approval of the Air Pollution Resolution by CCMS in 1971, and adoption by the North Atlantic Council in 1972.
- Some member countries drafted air pollution control legislation based on the results of the Pilot Study.
- The United Nations World Health Organisation integrated the results of the Pilot Study into its worldwide community air pollution programmes.

Air Pollution Assessment Methodology and Modelling:

- Adoption of the Pilot Study's 10 recommendations by CCMS and the North Atlantic Council in 1977. This was seen as a demonstration that Member nations were ready to move forward in solving air pollution problems through cooperative efforts.

Air Pollution Control Strategies and Impact Modelling:

- Made recommendation of the need for long-term research to establish the impact of low-dose heavy metals.
- Made recommendation that governments should implement controls to protect against irreversible health and ecosystem damage from pollutant transport across national boundaries.

Over 100 books, reports and technical papers were published by CCMS on air pollution topics. Representatives from the World Bank regularly suggest to developing nations that they consult CCMS air pollution experts for guidance in initiating air pollution management strategies.

ITMs have developed into a tradition of bringing experts together to discuss the application of existing air pollution models and the development of new models. This has led to significant advances in the areas of model development and validation.

The scientific transfer that takes place during ITMs is vast. Plenum Press publishes the proceedings, which includes the discussion after each presentation. They are highly respected publications that are often cited in other literature.

Output/Information Available

The ITM publications are available commercially from Plenum Press. The four most recent ones are: -

- Air Pollution Modelling and its Application X, Eds. Sven-Erik Gryning & Millan Millan, 1994.
- Air Pollution Modelling and its Application XI, Eds. Sven-Erik Gryning & Frank Schiermeier, 1996.
- Air Pollution Modelling and its Application XII, Eds. Sven-Erik Gryning & Nadine Chaumerliac, 1998.
- Air Pollution Modelling and its Application XIII, Eds. Sven-Erik Gryning & Ekaterina Batchvarova, 2000.

The current Chairman of the ITMs provides the following web-address for conference information: -

- http://www.risoe.dk/amv/itm

Further References

Plenum Press CCMS Series numbers: 1, 3, 5, 7, 10, 11, 13, 15, 17, 18, 21, 22

B.7 Methodology, Evaluation and Scope of Environmental Impact Assessment

Duration: 1991 to 2001 (scheduled closing workshop)
Pilot Study Director: Professor R F Verheyen, Belgium

Objectives

- To discuss and compare the different aspects of Environmental Impact Assessment (EIA), both procedural and methodological.
- To give recommendations to the authorities for improving the EIA process.
- To discuss the differences between the participating countries concerning procedures, scope, methodology, depth of applied information, and evaluation criteria used in EIA.
- To bring together different views on EIA in order to discuss and exchange the expertise in EIA outside the official and administrative frame.

Pilot Study Overview

Environmental Impact Assessment is a complex subject. The work of the Pilot Study is based on the organisation of semi-annual workshops. Each workshop deals with a specific theme related to the evaluation, methodology and scope of EIA. The participants of the Pilot Study select the themes.

The first phase (7 workshops: 1991 to 1994) focused on the following themes: -

- An evaluation of the EIA process in the participating countries.
- Methodological aspects of EIA and the possibilities of quality control.
- Public participation in the EIA process.

The second phase (6 workshops: 1995 to 1997) considered the following themes: -

- Effectiveness of EIA in decision-making.
- Post-evaluation in the EIA process.
- Strategic Environmental Assessment (SEA) or EIA on Policies, Plans and Programmes (includes: Experience of SEA in different countries; Integration of social and economic concerns in EIA; Methodologies to implement SEA on higher policy levels; Quantitative versus qualitative methods in SEA; SEA reviewing and public participation).
- SEA in land use planning (includes: Benefits of SEA in land use planning; SEA process in land use planning; case study examples).
- Integration of Health Impact Assessment and Risk Assessment in Environmental Assessment.

The third phase (estimated period 1997 to 2000) should constitute the finishing phase. The themes discussed in the 14th workshop of 1999 include: -

- Evaluation of quality control of EIA.
- EIA in Transport Infrastructure Planning.
- Transboundary impact and mitigation measures and project design of transport infrastructure projects (especially concerning biodiversity).

Other aspects of EIA raised at the end of 1997 for possible inclusion in the third phase include: -

- The practical implementation of EIA in sectional planning.
- Pollution control and EIA.
- Water management and EIA.
- A final update of the EIA processes and experiences in all the participating countries (essentially a follow-up to work carried out in the first phase).

Interim Conclusions of the Pilot Study

The final findings of the fourteen workshops organised to date are grouped under the following headings: -

- Evaluation of the EIA Process
- Methodological Aspects of EIA
- Evaluation of Public Participation in EIA.
- Strategic Environmental Assessment – Theory versus Practice.
- Strategic Environmental Assessment in land use planning.
- Quality Control in Environmental Assessment – results of a survey.

The Pilot Study has found that there are many differences between participating countries in respect of EIA procedures, scope, methodologies, depth of applied information and evaluation criteria used.

The Pilot Study will be finalised at the beginning of 2001 with an official publication that summarises and updates all the findings of the workshops and earlier publications.

Output/Information Available

The following "Blue Book" publications are available for this Pilot Study: -

- First Report: Evaluation of the EIA Process – Number 197
- Second Report: Methodological Aspects – Number 201
- Interim Report - Number 203
- Third Report: Evaluation of Public Participation in EIA – Number 207
- Fourth Report: Strategic Environmental Assessment – Theory versus Practice Number 212
- Fifth Report: Strategic Environmental Assessment in land use planning – Number 218
- Sixth Report: Quality Control in Environmental Assessment – results of a survey – Number 231

The Pilot Study Director has set up the web address: -

- http://www.instnat.be/nato-ccms

B.8 Review of Ongoing Black Sea Projects for the Planning of Future Activities

Duration: July 1996 to October 1997
Pilot Study Directors: Mr G Vest, USA and Dr U Unluata, Turkey

Objectives

- To present a science plan for a research and technological development programme to foster capabilities for predicting and monitoring the Black Sea ecosystems on a permanent basis - The Black Sea Observation and Forecasting System (BSOFS).

The Specific Objectives of the BSOFS are: -

- To determine to what extent the time-dependent behaviour of the system is predictable on time scales of weeks to months, and space scales from several kilometres to several hundreds of kilometres. (The programme should describe the processes, explain and understand the mechanisms involved, and determine the extent of the predictability of the system.
- To accumulate quantitative understanding of the interactions between small- meso- and large-scale physical and ecosystem processes.
- To study further the feasibility of modelling a coupled physical-biogeochemical system for the purpose of forecasting its variations on time scales of weeks to months.
- To develop a prototype permanent observation system for the physical-biological-chemical components of the Black Sea ecosystem at adequate space-time resolution for model initialisation and forecast through the construction of the following:

  - A basin-wide system to observe physical, biological, and chemical variabilities of the pelagic layer.
  - A remotely sensed observation system module.
  - A small-vessel, continuous observation systems program for the coastal and shelf areas.
  - A buoy/platform system for monitoring *in situ* bio-optical variables and currents.

- To develop data assimilative general circulation and nested regional/coastal/shelf nowcast/forecast models capable of predicting the current, temperature, and salinity fields on time scales of a few weeks to several months.
- To further develop or reconstruct coupled biochemical-physical interdisciplinary models to predict the variability of the lower trophic levels of the deep water and the coastal ecosystems as they are affected by anthropogenic forcing, synoptic variability, and climate fluctuations.

Project Overview

The environmental degradation in the Black Sea is the most severe of all the basins of the world's oceans. This is demonstrated by the dramatic changes in its ecosystem and living resources. The potential effects of long-term natural variability and climate change only exasperates current environmental problems by adding another dimension to the complexity and uncertainty about the causes, rate, and timing of the various factors. The Black Sea therefore deserves greater attention and effective environmental management.

The high costs associated with finding remedies to the environmental problems of the Black Sea will rapidly increase as its environmental quality declines further. Future environmental changes in the Black Sea need to be adequately predicted in order that options for solutions can be considered and their funding addressed. The capability to predict and monitor the ecosystems of the basin will significantly contribute to the sustainable development of the Black Sea, mainly through the development of better management of the marine environment, and protection of public health and safety.

The purpose of the BSOFS is to enhance the implementation of the Black Sea Strategic Action Plan (BS-SAP). The BS-SAP was signed in 1996 by the six Black Sea coastal countries in commitment to a pragmatic programme of action related to the region. The major concerns identified by the BS-SAP are (1) eutrophication and over-exploitation of marine natural resources, (2) poor coastal management, (3) inadequate sewage-collection systems and sewage treatment facilities, (4) industrial hot spots, and (5) lack of port reception facilities

In order to address its objectives, the Pilot Study was split into 4 Working Groups (WG): -

- WG1 was responsible for the review of ongoing environmental programmes in the Black Sea region. This review considered thirteen past and current programmes (three of which have been supported by NATO).
- WG2 was responsible for modelling and prediction. The group considered predictive ecosystem models with forecasting capabilities that use long-term, real- or near-real time systematic observations.
- WG3 was responsible for planning observation systems and process studies.
- WG4 coordinated the preparation of the plan.

Conclusions of the Project

The Pilot Study agreed that the BSOFS should be developed in 3 phases over a 10-year period. The first 2 phases relate to the further development of interdisciplinary coupled models capable of assimilating physical, biological and chemical variables; the construction of the observational network consisting of multiple platforms and sensors capable of sampling fields of a series of key variables; and the guarantee that the system contains multi-scale, nested components. The third phase will concentrate on meeting the Specific Objectives of the BSOFS.

The plan proposed by the Pilot Study will significantly contribute to the implementation of the BS-SAP in the following ways: -

- Addressing issues not covered by BS-SAP.
- Clarifying the basic causes of environmental degradation of the Black Sea ecosystem identified in the Black Sea Transboundary Diagnostic Analysis (TDA).
- Providing a scientific basis for the action proposed in the BS-SAP.
- Helping to solve the identified problems by understanding the processes involved using models as a tool.
- Monitoring the changes in the ecosystem that will occur after the implementation of proposed actions.
- Transferring science and technology to the decision makers to take actions.
- Establishing monitoring and forecasting systems in the Black Sea on a permanent basis.

- Predicting the Black Sea response to various forms of external effects using long-term monitoring through observation systems.
- Strengthening the Black Sea scientific community.
- Promoting and strengthening international collaboration of countries in the region (Figure B.2).

Output/Information Available

- CCMS "Blue Book" Series – Report number 221
- Yu Zaitsev and V Mamaev (GEF Black Sea Environmental Programme)
- Marine Biological Diversity in the Black Sea: A Study of Change and Decline. Black Sea Environmental Series, Volume 3 (NY: United Nations, 1997)

The following web-addresses are available: -

- CCMS link – http://www.nato.int/ccms/p00/p00.html (though this is not available as a link from the main CCMS web pages).
- Black Sea Environmental Programme – http://www.domi.invenis.com.tr/blacksea

Figure B.2 - Map showing countries that surround the Black Sea (from Blackseaweb, 1999)

References

CCMS (1998) Summary Final Report of the short term ad hoc project: Review of Ongoing Black Sea Projects for the Planning of Future Activities, EAPC (CCMS)D(98)4

Vest G and Unluata U (ed.s) (1997). Black Sea Observation and Forecasting System (BSOFS) Science Plan. USA, Department of Defense.

B.9 Review of Environmental Projects of the Caspian Sea for the Planning of Future Activities

Duration: March 1998 to September 1999
Pilot Study Director: Professor I Salihoglu, Turkey

Objectives

- To review the objectives and the accomplishments of all Caspian Sea programmes, whether completed or ongoing.
- To compile information on existing gaps of knowledge in the region.
- Compile a Caspian Sea Science and Implementation Plan.

The aims of the Caspian Sea Science and Implementation Plan are to: -

- Provide recommendations for future work aimed at resolving the missing elements in environmental research in the region.
- Identify the specific anthropogenic and natural causes of environmental problems in the region.
- Identify the gaps of knowledge to quantify key variables and processes to be studied.

Project Overview

The ecosystem of the Caspian Sea is becoming increasingly affected by natural and anthropogenic impacts. The Caspian Sea is unique because of its completely enclosed geometry (Figure B.3). It supports an important range of indigenous and other species of marine life that are facing increasing threat. The surrounding environment is suffering from increased flooding due to the rising sea level, that brings the additional problem of secondary contamination. The problems of contamination are expected to increase with the development of the oil industry in the area. The health and well being of the ecosystem of the Caspian Sea, with its important natural resources, is of high economic importance to the surrounding states of Azerbaijan, Iran, Kazakhstan, Russia and Turkmenistan.

Figure B.3 - Map showing the countries that surround the Caspian Sea (from Environment Information Administration, 2000).

The Pilot Study was split into two working groups. Working Group I carried out a review of past and present activities in the Caspian Sea. Working Group II considered data observation and warning systems, and predictive modelling issues. The first part of the Pilot Study considered general aspects, geography and physical characteristics, environmental issues, fauna and migration, and the natural resources of the Caspian Sea. It also considered the socio-economic aspects split between the countries bordering the Caspian Sea.

The Pilot Study Report lists the past and ongoing national activities relating to environmental issues of the Caspian Sea. It also provides an overview of the international activities relevant to the Region. A number of international agencies have been active, including International Atomic Energy Agency (IAEA), World Meteorological Organisation (WMO), United Nations Educational Scientific & Cultural Organisation (UNESCO), International Oceanography Commission (IOC), Food & Agricultural Organisation (FAO), United Nations Development Programme (UNDP), UNEP, World Health Organisation (WHO), World Bank, EU and NATO.

The Caspian Sea is of global interest because of its unique characteristics. The information gained from monitoring events in the Caspian Sea could provide knowledge of benefit to other regions of the world's oceans. Its enclosed geometry provides a controlled environment for developing Coupled Interdisciplinary Models, and studying the effects of anthropogenic forcing, as well as synoptic climatic variability, on a sensitive system. All these could contribute to a greater understanding of ocean and atmospheric processes common to other areas of the world's oceans. Lastly, the Caspian Sea is an area with greater sensitivity to Global Change. It therefore provides an opportunity to study the level of atmosphere/ocean/land climatic and hydrologic coupling necessary for successful predictions, as well as to demonstrate their effects on key indicators such as sea-level change.

The Pilot Study reviewed the requirements of the Caspian Sea and Observation and Forecasting System in terms of scientific rationale, goals and approach, marine and atmospheric processes, modelling, development of a regional database management system, and links to other programmes and end users.

Conclusions of the Project

The conclusions arrived at by the Pilot Study Group can be summarised as follows: -

- Environmental problems of the Caspian Sea are the joint result of natural climatic change and anthropogenic forcing, which threatens its ecosystem, in addition to the well being of people in the surrounding lands.
- There are signs that suggest there is a risk of rapid, precipitous collapse of the Caspian Sea's ecosystem by eutrophication resulting from increased loads of nutrients. This is a familiar threat to an enclosed sea, and one that has been experienced in the neighbouring Black Sea. Increased human activities make the situation worse.
- The emigration of alien species to and from the Caspian Sea is a serious problem for the Caspian Sea as well as other parts of the world affected by the exports.
- Recent sea-level changes have had important consequences for the economic well being of the region. The rise in sea level together with increased metabolism due to higher pollution loads, could lead to changes in the biogeochemical composition of the Caspian Sea.

- The Caspian Sea's inherent sensitivity to external forcing implies relatively large changes in its environment can occur in response to small changes in driving forces of natural and anthropogenic origin.
- It is necessary to construct a Caspian Sea Observation and Forecasting System with the aim of decreasing uncertainties in predicting the behaviour of the Caspian Sea under natural and anthropogenic forcing. The objectives should be: -

  - To have multidisciplinary investigations establishing an understanding of the history and present state of the system. This needs to cover (i) the physical mechanisms playing roles in the system, (ii) the key variables and processes influencing system behaviour, (iii) the linkages between the system elements and the neighbouring and remote climatic systems, (iv) the coupling between the physical and biogeochemical sub-systems, (v) the fluxes and budgets of energy and matter within the system, (vi) the sources and transports of pollutants and other factors affecting environmental quality, (vii) ecosystem security and preservation, (viii) involuntary import or exports of alien species, and (ix) paleoecology and biodiversity of marine life.
  - To have an understanding of the integrated and interactive behaviour of the environment through investigations of the climate system on a regional scale, and to establish links with global systems. This is in view of the need (i) to develop ocean and atmospheric circulation models of the Caspian Sea region, including realistic air-sea/riverine momentum and buoyancy fluxes, sea-level changes, flooding and ice thermodynamics, atmosphere-land-sea interactions, transport of materials, (ii) use coupled models consisting of the physical, chemical and biological components, (iii) develop methods to use or assimilate observed data in these models, (iv) to make studies of a wide range of climate processes such as up-welling, ventilation, desertification, desiccation, material or heat transport, (v) to make assessments on stability and predictability of system components, and (vi) to reduce uncertainties in the mass balances through integrated studies of freshwater budgets, exchanges and sea-level changes.

- The objectives of the Caspian Sea Observation and Forecasting System can only be achieved through 1) Establishment of cooperation and infrastructures to enable or continue data collection, archiving and exchange, 2) Harmonisation of activities with existing programmes to make use of the research means already facilitated by regional institutions, 3) Use of sea-level monitoring and analysis as an integral measure of the success of predictive tools used in the region, 4) Making extensive use of earth system observation technology with satellites and other multi-purpose platforms, 5) Analyses of the contemporary and past observations, and 6) development of supporting Data and Information Systems to make results available to the community.

Output/Information Available

- CCMS "Blue Book" Series – Report number 239

Further References

CCMS (1999) Summary Final report. Short term ad hoc project: Review of Environmental Projects of the Caspian Sea for the Planning of Future Activities. EAPC(CCMS)D(99)13

Salihoglu I and Ozsoy E (ed.s) (1999). Review of Environmental Projects of the Caspian Sea for the Planning of Future Activities. Ankara, METU.

B.10 Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater – Phases I And II

Duration: Phase I – 1986 to 1991 Phase II – 1992 to 1997
Pilot Study Directors: Phase I – Mr D E Sanning, USA
Phase II – Mr S C James, Dr W Kovlick, USA

Objectives

Phase I: -

- To identify and evaluate innovative, emerging and alternative remediation technologies.
- To transfer technical performance and economic information to potential users.
- To identify "lessons learned" from the technology demonstration, including not only the successes, but also lessons illustrating technology failures or limitations.

Phase II: -

- To identify, discuss, and review innovative, emerging and alternative technologies.
- To exchange technical information on demonstrated technologies.
- To exchange information on the development of emerging and innovative technologies.
- To transfer technical performance and economic information to potential users of the technologies.
- To identify "lessons learned" from the technology demonstration – both the successes and those that illustrated technology failures or limitations.
- To recommend, develop and adopt information data reporting methods for results of technology studies (demonstration, bench, pilot and other technology studies).

Pilot Study Overview

Groundwater and soil contamination are amongst the most complex and challenging environmental problems faced by most countries today. This challenge results from a number of significant factors, such as the complex geochemical, physical and biological nature of contaminated subsurface soils and groundwater; limited knowledge regarding the behaviour and interaction of pollutants within these environmental matrices; and the sheer magnitude of the contamination. These factors, in turn, limit the application and effectiveness of conventional waste treatment technologies and result in high remediation costs.

Under Phase I, twenty-nine remediation technology projects were examined which treat, recycle, separate or concentrate contaminants in soil, sludges and groundwater. The emphasis was on *in situ* and on-site technologies. However, in some cases, e.g. thermal treatment, fixed facilities off-site were also examined. Technologies included were: thermal, stabilisation/solidification, soil vapour extraction, physical/chemical extraction, pump and treat groundwater, chemical treatment of contaminated soils, and microbial treatment.

The success of the Phase I Pilot Study led to the inception of the Phase II Pilot Study in 1992. Phase II was conducted similarly to Phase I, but was extended in scope to include technologies at an even earlier stage of development. Phase II acknowledged that many countries have committed resources to developing advanced, innovative remediation

technologies, and to evaluating them under field conditions. However, the Pilot Study Group stated the ongoing challenge is how to maximise the value of these technology demonstrations and effectively transfer the technologies both within and between countries. In addition, there has been an increasing recognition of the need for approaches not dependent on advanced technologies and for technologies that can be cost-effectively employed in the socio-economic circumstances of Eastern and Central Europe and developing countries.

The Pilot Study defined emerging technologies as being at bench or pilot scale. Demonstrated technologies were defined as projects implemented at field or full scale. Fifty-two different remediation technology projects from fourteen countries were examined over the course of Phase II. The projects included *in situ* and *ex situ* biological, physical-chemical, and thermal treatment technologies. Many of the projects involved two or more technologies, either in integrated treatment systems or in parallel treatment.

The technologies described in each technical project were broadly classified as one of six types (number of projects shown in brackets): biological (24), chemical (4), physical-chemical (24), stabilisation/solidification (2), thermal (5), or others (4). (Note that some projects were counted twice). The Final Report contains project summaries that provide technical abstracts and names of technical contacts for further information. The technical abstracts summarise the progress and results of the projects, rather than provide a critical review.

Conclusions of the Pilot Study

The conclusions arising from the Phase I Study can be summarised as follows: -

- Energy efficiency practices influence plant design and, therefore, processing costs in different countries.
- Treatment and permanent solutions are preferred
- Integrated technology treatment systems are needed for site remediation.
- Field treatability/Pilot Studies should be conducted for each technology under consideration, under the range of potentially applicable site field conditions.
- Technology scale problems need to be addressed in design and testing.
- A mass balance approach to remediation is desirable.
- Technology remedies that transfer contaminants from one media to another should be avoided, if possible.
- All remediation requires proper operation and management.
- Long term monitoring of permanent remediation may be necessary to ensure that clean-up goals are met.
- Basic records should be preserved.
- Uniform data collection is needed.
- Independent technology evaluations are needed for effective technology transfer.
- The NATO/CCMS network is an important source of information.
- There is a continuing need for development of new technologies and use of common research protocols.
- Scientific understanding of processes is essential in order to ensure against formation of harmful end products.
- Standardisation of analytical methods is needed.
- Techniques are needed to remove contamination beneath urban structures without significant disturbance to ongoing activities.

The conclusions for Phase II were classified under four headings: General conclusions arising from the Pilot Study; General conclusions about remediation and technology transfer; Conclusions relating to individual chapters of the Report; Research needs.

The Phase II conclusions considered of particular importance are: -

- A number of countries are moving their remediation strategies from technology-intensive treatment processes to increasing use of land use management and extensive approaches such as natural attenuation.
- The intended future use of a site is increasingly a determining factor when setting clean-up objectives and selecting a remediation strategy.
- Integrated treatment systems are frequently needed for site remediation.
- Plant design is influenced by energy-efficiency practices resulting in varying processing costs between countries. This makes cost comparisons between countries and choice of different technologies difficult to make.
- All remediation activities require proper operation and management.
- Effective technology transfer requires independent evaluation and verification of technologies, and uniform data collection.
- Scientific understanding of processes is essential to avoid forming harmful end products and by-products, ensuring process optimisation, avoiding unwanted transfer of contaminants to other media, and understanding the limits of technical performance.

Output/Information Available

- Phase I – CCMS "Blue Book" Series – Report number 190 (2 volumes)
- Phase II – CCMS "Blue Book" Series – Report numbers 203 (Interim) and 219 (final).

US EPA (1999) CD-ROM for Phase I and II (and Phase III) Reports. Order Number EPA 542-C-99-002. Contains many EPA reports from the Pilot Study.
Note Phase III "Blue Book" Series reports so far are: 228, 229, 235, 236, 244, 245

Information is also available on the following web-addresses: -

- CCMS – http://www.nato.int/ccms/pilot-studies/pilot007/document.htm#3 (supports documents for Phases II and III)
- USA EPA – http://www.clu-in.org/intuptxt.htm#NATO

Further References

CCMS (1992) Summary Final Report of the Pilot Study on Demonstration of Remedial Action Technologies for Contaminated Land and Groundwater, AC/274-D/305

CCMS (1998) Summary Final Report of the Pilot Study on Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean Up of Contaminated Land and Groundwater, AC 274(INV)-D(98)5

Sanning D E et al (1991). Demonstration of Remedial Action Technologies for Contaminated Land and Groundwater. USA, Environmental Protection Agency.

Smith M A (ed.) (1985). Contaminated Land: Reclamation and Treatment. New York, Plenum.

Smith M A (ed.) (1998). Evaluation of Demonstrated and Emerging Technologies for the Treatment and Clean up of Contaminated Land and Groundwater. Maryland, Environmental Management Support.

B.11 Dose-Response Analysis and Biologically-Based Risk Assessment for Initiator & Promoter Carcinogens

Duration: 1990 to 1996
Pilot Study Director: Dr G A Zapponi, Italy

Objectives

- To provide theoretical and methodological contributions to improve Biologically-Based modelling
- To provide a theoretical contribution and a practical method proposal in respect of carcinogenic risk assessment, including consideration of toxicodynamic and toxicokinetic modelling.
- To consider the different methods and approaches for carcinogenic risk regulation adopted by Member countries.

Pilot Study Overview

The main topics treated in the Pilot Study are; Basic assumptions in carcinogenic risk assessment; Biological basis; Data sources; The use of biomarkers in risk assessment; Multistage models; Biologically-based models including pharmacokinetic modelling; Statistical considerations; Case studies and practical applications.

The topics above, which represent the chapters of the Final Report, have been considered with a multidisciplinary approach by several authors who are experts in different fields, and include both theoretical and practical information.

Significant differences in respect of cancer risk assessment and regulation have been revealed, following a review of the procedures adopted in member countries/areas, including the EU, The Netherlands, UK, Germany, Denmark, Norway, and USA. Differences mostly relate to the theoretical and methodological approaches rather than the final risk evaluation and risk regulation practical criteria.

Biologically Based Modelling may be a useful tool towards achieving harmonisation of carcinogenic risk assessment methods in NATO Member countries. Such harmonisation could be extended to include non-carcinogenic and carcinogenic risk assessment through the use of a Benchmark Dose approach.

The Pilot Study identified *in vitro* tests relevant to carcinogenesis and cell proliferation, dose-response relationships, and toxicokinetic data, all as being sources of data of possible interest for Biologically Based Modelling. Such data is also essential for proper interpretation, use and interspecies extrapolation of dose-response relationships and parameters. Variability in cancer risk and individual susceptibility are now recognised to be of high importance in cancer risk assessment.

Biomarkers relevant to cancer risk are recognised as an important source of data that may integrate and further the power of epidemiological surveys, provide basic information for the evaluation of the risk to which human populations, sub-groups and individuals are exposed and guide prevention activity.

The Pilot Study provides a critical review of the Armitage-Doll Linearised Multistage Model. The main concerns identified are 1) It only considers the irreversible events (mutations) causing the transition of the involved cell through successive stages, without taking into account the clonal expansion of intermediate and malignant cell populations, and 2) It uses some mathematical approximations that may not be considered appropriate in all cases. In view of this, the Pilot Study considered other models better suited for a detailed description of the most relevant biological events.

The development of two-mutation clonal expansion models allows the use of parameters which represent biological "observables" that can be measured or tested, and have a precise biological meaning. This model allows for a classification of carcinogenic agents into initiators, promoters, and completers, with specific reference to model parameters. The Pilot Study Report presents a quantitative formulation of the models, and includes the mathematical details necessary for practically treating and implementing the models on a personal computer.

Carcinogenic risk assessment is often based on animal experimental data, particularly in the absence of epidemiological data. Physiologically Based Toxicokinetic (PBTK) Models are used for estimating target tissue doses and providing a sound basis for interspecies extrapolation. Studies have indicated that life, breath and heartbeat duration, pulse time, blood flow rates, as well as the rates of other parameters, are approximately constant across different species if expressed in "physiological time". The Pilot Study's Final Report includes a detailed quantitative review of PBTK models and of interspecies scaling of relevant physiological parameters.

Carcinogenic risk assessment is typically based on the selection and use of sets of experimental data or observations, on their interpretation in the light of theoretical models, and on data fitting models, that are theoretically justified. The Pilot Study has considered the mathematical and statistical considerations that need to be taken in to account for modelling procedures and results. This is deemed particularly important for risk estimates obtained from different models in the low-dose range.

Biologically Based risk assessment has been profitably used to analyse specific cases, solve problems and provide risk estimates of practical interest. The Pilot Study looked at case studies and information examples that highlight the possibilities and difficulties associated with this type of risk assessment.

Conclusions of the Pilot Study

The Conclusions and Recommendations of the Pilot Study are addressed in the Final Report under the following categories of questions: 1) What does each source of experimental data contribute to our knowledge and ability to model? 2) What kinds of information are needed to develop a biologically based model? 3) How does linearity enter into empirical models and biologically based models? 4) How does a biologically based model help us understand intraspecies variability? 5) How does a Biologically Based model help us understand interspecies variability? And 6) what are the uncertainties associated with a Biologically Based model?

The main points raised by the Pilot Study are: -

- The importance of attentively examining and discussing the mechanisms involved, or possibly involved, in the process under study for cancer risk assessment. This means making the most of available data, including in vitro and short term tests, animal bioassays, epidemiological data possibly available, cell proliferation studies, target tissues, intermediate lesions, biomarkers, relevant metabolic pathways and interactions of parent compound and/or of its metabolites with Deoxyribonucleic Acid (DNA), and other relevant processes and parameters.
- The use of biologically based risk assessment methods is recommended whenever sufficient information is available.
- A major objective for future research is the evaluation of individual susceptibilities in humans. The use of relevant biomarkers may provide information useful for this purpose, and can be incorporated into Biologically Based Modelling.
- Interspecies extrapolation of toxicological parameters should consider both the toxicokinetics and the toxicodynamics of the process of interest.
- Each estimate used in risk assessment should include an appropriate uncertainty evaluation.
- Models should properly reflect the physical, chemical and biological reality, capturing the essential biological processes that can be observed, even if they may be too complex to describe in every detail. This makes questions about low-dose behaviour modifications due to the possible presence of threshold or saturation phenomena easier to address.

Output/Information Available

- Perspectives on Biologically Based Cancer Risk Assessment – Plenum Publishers – Volume 23 – ISBN number 0-306-46108-0

- Summary Report – Central Europe Journal of Public Health (Zapponi & Cogliano, 1998, 684: 317-320).
- "Risk Assessment of Complex Mixtures: Some Considerations on Polycyclic Aromatic Hydrocarbons" – Journal of Environmental Toxicology & Oncology 16 (2&3)

Further References

CCMS Report (1996) Dose Response Analysis and Biologically Based Risk Assessment for Initiator and Promoter Carcinogens. Document AC/274-D/361

Cogliano V J, Luebeck E G and Zapponi G A (ed.s) (1999). Perspectives on Biologically Based Cancer Risk Assessment. New York, Kluwer Academic & Plenum.

B.12 Indoor Air Quality

Duration: Phase I - 1988 to 1994 Phase II - 1994 to 1997
Pilot Study Director: Professor M D Maroni, Italy

Objectives

Phase I: -

- To develop a network of the agencies, institutions, and individuals responsible for establishing policy and regulations on indoor air quality issues within individual NATO nations.
- To examine policy strategies and propose a range of options that could be adopted by NATO nations.
- To identify research efforts and develop a registry of research contacts; characterise indoor air quality problems in NATO countries; identify priority problems that propose high risks to human health and materials; and, identify, study and recommend mitigation or control methods.

Phase II: -

- Establishment of a network of key individuals in Eastern European countries and in the new Independent States who are involved in a technical or policy capacity in disciplines that are of importance to indoor air quality.
- Identification of information and training needs of the Eastern European countries and the new Independent States and development of appropriate strategies for meeting these information needs and assisting these countries in establishing institutional capabilities to address indoor air quality issues.
- Translation of key documents from the Pilot Study and other sources into Russian and other Eastern European languages.

Pilot Study Overview

Phase I included a programme of scientific meetings on: 1) Implications of indoor air quality risks, 2) Managing indoor air quality risks, 3) Energy and building sciences in indoor air quality, 4) Epidemiology and medical management of building-related complaints and illnesses, 5) Methods of risk assessment for the indoor environment, 6) Sampling and analysis of biocontaminants and organics in non-industrial indoor environments, and 7) Indoor air quality for health. The CCMS Final Report provides abstracts of the presentations given at each meeting.

The essential elements of indoor air quality discussed over the course of the meetings were: -

- Indoor air pollutants, sources, and other factors affecting indoor air quality - The Group considered indoor air quality issues in relation to the time people spend indoors, modern building design, categories of indoor air pollutants, sources of indoor pollutants, the effect of heating, ventilation and air-conditioning systems, and the importance of the pathway between pollutant sources and the occupant.

- Effects of indoor air pollutants on human health - The Group discussed the problems of diagnosing indoor air quality health effects due to the fact that many symptoms are similar to those of other disorders. Building Related Illness (BRI), Sick Building Syndrome (SBS), air pollutants that may be carcinogenic, Multiple Chemical Sensitivity (MCS) Syndrome, and susceptible groups of people were all discussed.
- Evaluation and management of symptoms related to the indoor environment - The Group looked at what physicians should be attempting to ascertain in the identification of the cause of patients symptoms.
- Risk Assessment - The Pilot Study agreed an outline of the procedures required to identify and quantify the risks posed by pollutants. An appreciation of the variables involved, particularly when considering dose-response relationships and combinations of pollutants, is essential.
- Risk Management - The Pilot Study considered the factors involved in developing both regulatory and non-regulatory risk management strategies for addressing indoor air quality risks.
- Methods of indoor air quality investigation - The Group outlined some of the factors an indoor air quality investigation should consider in an attempt to identify and solve indoor air quality problems in a way that prevents the problems from recurring or creating other problems.
- Indoor air quality control and remediation - The Pilot Study discussed source control, ventilation and air cleaning, and exposure control as possible indoor air quality control strategies.

At the second meeting of Phase I, participants decided an international inventory of existing indoor air quality programmes, regulations and guidelines would be a useful tool for comparing risk management strategies. The results of the inventory are provided in the CCMS Final Report.

Phase II of the Pilot Study consisted of several meetings and workshops, one of which was a NATO Advanced Research Workshop. This was held in conjunction with the international conference Healthy Buildings ’95, and was titled “Ventilation and Indoor Air Quality in Hospitals”. This workshop was made possible through the funding support of, *inter alia*, the NATO Scientific and Environmental Affairs Division.

The aim of the final meeting, which was held in Erice, Italy, was to perform a global review of the activities performed in the Pilot Study. It was noted that a significant body of knowledge from around the world on indoor air sciences had been accumulated. To encourage the development of appropriate national policies on indoor air quality and the process of technical knowledge dissemination, the meeting decided to prepare the following documents to assist participating governments in educating key groups about indoor air quality protection. They were drafted by groups and discussed in plenary: -

- The Erice Statement for Sustainable Indoor Environment – This document indicates how a national plan for a sustainable indoor environment can be developed and organised by governments and national institutions.
- Indoor Air Quality Planning, Design, and Construction Practices: A Team Effort - A document that outlines the demanding indoor air quality challenges faced by building designers and builders who are responsible for creating comfortable indoor environments with clean indoor air.

- Ten Facts That Every Building Operator, Manager, Planner and Occupant Should Know About Indoor Air Quality – A short pamphlet explaining the main issues concerning indoor air in buildings and providing guidance on how inconvenient features can be prevented and remedied.
- Good Air Quality in Your Home – A pamphlet addressed to the general public with the purpose of explaining where the air pollutants found in houses come from and how one can avoid them affecting his/her health.
- What Medical Doctors Should Know About Indoor Air Quality – A short document that summarises the most relevant and important aspects of indoor air quality for the medical profession.

Conclusions of the Pilot Study

The conclusions for Phase II aimed to summarise the main issues arising from the whole Pilot Study: -

- Indoor environments are those where human beings spend most of their time in modern societies.
- Pollution and degradation of indoor air causes illness, increased mortality, loss of productivity and can have major economic and social implications. Indoor air problems are related to inadequate urban planning, design, operation and maintenance of buildings, materials and equipment in buildings, and inappropriate energy saving.
- Indoor air quality problems affect all types of buildings including homes, schools, offices, health care facilities and other public and commercial buildings. Health effects can include increased rates of cancer, lung disease, allergy and asthma as well as fatal conditions such as carbon monoxide poisoning and Legionnaires' Disease. Worldwide, the medical and social cost associated with these illnesses and the related reduction in human productivity result in staggering economic losses.
- Many of the problems associated with poor indoor air quality can be prevented at low cost and without compromising energy efficiency if governments develop and implement an integrated strategy for the indoor environment in concert with all social and economic partners.
- The achievement of a sustainable indoor environment is a challenge for governments and international organisations. Each national community should contribute with its specific knowledge and should be able to learn from other countries' experience. It is therefore of utmost importance to promote international cooperation in science and technology related to indoor air.

The Pilot Study also recommended governments should establish a "National Plan for a Sustainable Indoor Environment" concerning new construction as well as existing buildings. An outline of the suggested structure was agreed.

Output/Information Available

- CCMS "Blue Book" Series – Report numbers (All Phase I) 183, 186, 187, 192 and 195 (Final Report).
- NATO ASI Series - Ventilation and Indoor Air Quality in Hospitals – ISBN number 0-7923-4076-0
- Indoor Air Quality: A Comprehensive Reference Book – Elsevier Science BV, 1995

The following pamphlets/short documents were produced during Phase II in co-operation with the University of Milan (1999): -

- Erice Statement on Indoor Air Quality for a Sustainable Indoor Environment
- Indoor Air Quality Planning, Design, and Construction Practices: A Team Effort.
- Medical Aspects of Indoor Air Quality.
- 12 Things Every Building Owner and Manager Should Know About Indoor Air Quality.
- Good Air Quality in Your Home

The information contained in "Medical Aspects of Indoor Air Quality" is adapted from a document published jointly by US EPA, US Consumer Product Safety Commission, the American Medical Association, and the American Lung Association. The original publication is available online at: -

- http://www.epa.gov/iaq/pubs/hpguide.html (a Spanish version is also available from this address).

The Pilot Study recommended the following web addresses for further information on indoor air quality information: -

- http://www.who.ch - World Health Organisation
- http://www.cdc.gov - US Centers for Disease Control
- http://www.bre.co.uk - UK Building Research Establishment
- http://www.ashrae.org - American Society of Heating, Refrigeration, and Air Conditioning Engineers.
- http://www.boma.org - Building Owners and Managers Association International
- http://www.epa.gov/iaq - US EPA
- http://www.nist.gov - US National Institute of Standards and Technology
- http://www.cyberus.ca/~dsw - International Society of Indoor Air Quality and Climate
- http://www.cmhc-schl.gc.ca - Canada Mortgage and Housing

Further References

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CCMS Report (1995) Indoor Air Quality. Document AC/274-D/345,

CCMS Report (1998) Indoor Air Quality Phase II. Document EAPC(CCMS)D(98)1

NATO CCMS (1997). 12 Things Every Building Owner & Manager Should Know About Indoor Air Quality. USA, Environmental Protection Agency.

NATO CCMS (1997). Erice Statement on Indoor Air Quality for a Sustainable Indoor Environment. USA, Environmental Protection Agency.

NATO CCMS (1997). Good Air Quality in Your Home. USA, Environmental Protection Agency.

NATO CCMS (1997). Indoor Air Quality Planning, Design and Construction Practices: A Team Effort. USA, Environmental Protection Agency.

NATO CCMS (1997). Medical Aspects of Indoor Air Quality. USA, Environmental Protection Agency.