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REPORT OF THE OECD WORKSHOP ON NEW DEVELOPMENTS IN CHEMICAL EMERGENCY PREPAREDNESS AND RESPONSE

Lappeeranta, Finland

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REPORT
of the OECD WORKSHOP ON NEW DEVELOPMENTS IN CHEMICAL EMERGENCY PREPAREDNESS AND RESPONSE

Lappeenranta, Finland, 3rd - 6th November, 1998

Some OECD publications related to chemical accident prevention, preparedness and response:

Guiding Principles for Chemical Accident Prevention, Preparedness and Response: *Guidance for Public Authorities, Industry, Labour and Others for the Establishment of Programmes and Policies related to Prevention of, Preparedness for, and Response to Accidents Involving Hazardous Substances* (1992) (Under revision)

International Directory of Emergency Response Centres (first edition, 1992) [prepared as a joint publication with UNEP-IE; under revision]

Report of the OECD Workshop on Strategies for Transporting Dangerous Goods by Road: Safety and Environmental Protection (1993)

Health Aspects of Chemical Accidents: *Guidance on Chemical Accident Awareness, Preparedness and Response for Health Professionals and Emergency Responders* (1994) [prepared as a joint publication with IPCS, UNEP-IE and WHO-ECEH]

Guidance Concerning Health Aspects of Chemical Accidents. *For Use in the Establishment of Programmes and Policies Related to Prevention of, Preparedness for, and Response to Accidents Involving Hazardous Substances* (1996)

Report of the OECD Workshop on Small and Medium-sized Enterprises in Relation to Chemical Accident Prevention, Preparedness and Response (1995)

Guidance Concerning Chemical Safety in Port Areas. *Guidance for the Establishment of Programmes and Policies Related to Prevention of, Preparedness for, and Response to Accidents Involving Hazardous Substances. Prepared as a Joint Effort of the OECD and the International Maritime Organisation (IMO)* (1996)

New OECD Series on Chemical Accidents:

No. 1, Report of the OECD Workshop on Risk Assessment and Risk Communication in the Context of Chemical Accident Prevention, Preparedness and Response (1997)

No. 2, Report of the OECD Workshop on Pipelines (Prevention of, Preparation for, and Response to Releases of Hazardous Substances (1997)

No. 3, International Assistance Activities Related to Chemical Accident Prevention, Preparedness and Response: Follow-up to the Joint OECD and UN/ECE Workshop to Promote Assistance for the Implementation of Chemical Accident Programmes (1997)

No. 4, Report of the OECD Workshop on Human Performance in Chemical Process Safety: Operating Safety in the Context of Chemical Accident Prevention, Preparedness and Response (1999)

No. 5, Report of the OECD Workshop on New Developments in Chemical Emergency Preparedness and Response (2001)

No. 6, Report of the OECD Expert Meeting on Acute Exposure Guideline Levels (AEGLs)
(2001)

About the OECD

The Organisation for Economic Co-operation and Development (OECD) is an intergovernmental organisation in which representatives of 30 industrialised countries in North America, Europe and the Pacific, as well as the European Commission, meet to co-ordinate and harmonise policies, discuss issues of mutual concern, and work together to respond to international problems. Most of the OECD's work is carried out by more than 200 specialised Committees and subsidiary groups made up of Member country delegates. Observers from several countries with special status at the OECD, and from interested international organisations, attend many of the OECD's Workshops and other meetings. Committees and subsidiary groups are served by the OECD Secretariat, located in Paris, France, which is organised into Directorates and Divisions.

The work of the OECD related to chemical accident prevention, preparedness and response is carried out by the Working Group (formerly Expert Group) on Chemical Accidents, with Secretariat support from the Environment, Health and Safety Division of the Environment Directorate. The objectives of the Chemical Accidents Programme include exchange of information and experience, analysis of specific issues of mutual concern in Member countries, and development of guidance materials related to chemical accident prevention, preparedness and response. As a contribution to meeting these objectives, over a dozen Workshops have been held since 1989.

As part of its work on chemical accidents, the OECD has issued several Council Decisions and Recommendations (the former legally binding on Member countries), as well as numerous Guidance Documents and technical reports (see partial list on page 5 and 6). Publications include the OECD's *Guiding Principles for Chemical Accident Prevention, Preparedness and Response*; *Guidance Concerning Chemical Safety in Port Areas* (a joint effort with the IMO); *Guidance Concerning Health Aspects of Chemical Accidents*; the joint IPCS/OECD/UNEP/WHO publication, *Health Aspects of Chemical Accidents*; and the joint OECD/UNEP *International Directory of Emergency Response Centres* (currently being revised by the OECD, UNEP-TIE and the Joint UNEP/OCHA Environment Unit).

The Environment, Health and Safety Division produces publications in seven series: **Testing and Assessment**; **Good Laboratory Practice and Compliance Monitoring**; **Emission Scenario Documents, Pesticides**; **Risk Management**; **Harmonisation of Regulatory Oversight in Biotechnology**; and **Chemical Accidents.** More information about the Environment, Health and Safety Programme and EHS publications is available on the OECD's web page.

This publication was produced within the framework of the Inter-Organisation Programme for the Sound Management of Chemicals (IOMC).

The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 by UNEP, ILO, FAO, WHO, UNIDO and the OECD (the Participating Organisations), following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. UNITAR joined the IOMC in 1997 to become the seventh Participating Organisation. The purpose of the IOMC is to promote co-ordination of the policies and activities pursued by the Participating Organisations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

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FOREWORD

This report presents the main output of the OECD Workshop on *New Developments in Chemical Emergency Preparedness and Response,* which took place in Lappeenranta, Finland on 3 – 6 November 1998. The Workshop was hosted by the Government of Finland in co-operation with the UN/ECE Regional Co-ordinating Centre for the Industrial Accidents Convention in Poland. The Workshop was organised by the OECD in co-operation with the UN/ECE, and with the support of the European Commission.

Approximately 90 experts from 21 countries attended the workshop, including representatives of public authorities, international organisations, research institutes and universities, industry, and other non-governmental organisations. They included participants from Central and Eastern European countries, as part of the continuing co-operation between the OECD and the UN/ECE (see List of Participants in Annex 2).

The purpose of this Workshop was to provide an opportunity for experts from different countries and different sectors concerned with the chemical emergency preparedness and response to share experience and develop recommendations on best practices to assist industry, public authorities and other stakeholders. In addition, the Workshop provided an opportunity to facilitate implementation of the UN/ECE Convention on the Transboundary Effects of Industrial Accidents and the revision of the OECD *Guiding Principles for Chemical Accident Prevention, Preparedness and Response (1992).*

The first part of the report consists of the Workshop Conclusions and Recommendations. This is followed by the Discussion Document (see Annex 1) prepared for the Workshop. An earlier version of the Discussion Document was presented at the Workshop; it was then revised in light of comments received during the Workshop. This report also contains, in the appendices, two other documents of interest: "Analysis of Risk Assessment Methods used in Different EU-Countries and in Norway" (part of a report prepared in the framework of European Union co-operation in the field of civil protection); and "Expert Systems for Emergency Response."

The OECD's Working Group on Chemical Accidents recommended that this report be forwarded to the Joint Meeting of the Chemicals Committee and Working Party on Chemicals, for consideration as an OECD publication. The Joint Meeting agreed that it be should be made available to the public. It is published under the authority of the Secretary-General of the OECD.

The documents in this publication have not been endorsed by, and do not necessarily reflect the views of, the OECD or its Member countries.

WORKSHOP ON NEW DEVELOPMENTS IN CHEMICAL EMERGENCY PREPAREDNESS AND RESPONSE

(Lappeenranta, Finland, 3rd - 6th November, 1998)

CONCLUSIONS AND RECOMMENDATIONS

Introduction

1. The Workshop on New Developments in Chemical Emergency Preparedness and Response was held in Lappeenranta, Finland, 3rd - 6th November 1998. It was hosted by the Government of Finland in co-operation with the UN/ECE Regional Co-ordinating Centre for the Industrial Accidents Convention. in Poland It was organised by the OECD (within the context of the OECD Chemical Accidents Programme) in co-operation with the UN/ECE, and was supported by the European Commission.

2. The Workshop brought together approximately 90 experts from 21 countries including representatives of public authorities, international organisations, research institutes, universities and industry. This included representatives of countries of Central and Eastern Europe, as part of the continuing co-operation between OECD and the UN/ECE. There were also representatives from IPCS, UNEP-IE and IMO/UNEP (REMPEC) also representing IMO (see list of participants in Annex 2).

3. The objectives of the Workshop were to:

- review major developments in the 1990s related to emergency planning and response in the context of chemical accidents;
- share experiences and identify lessons learned to improve preparedness and response;
- identify areas where further action is needed;
- develop recommendations on best technical and managerial practices to assist industry, public authorities and other stakeholders; and
- facilitate implementation of the UN/ECE Convention on the Transboundary Effects of Industrial Accidents and the review and revision of the *OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (in particular Section E).

Conclusions and Recommendations

4. The Workshop reached the following Conclusions and **Recommendations** in eight general areas. There were, however, a couple of common themes throughout the Workshop, in particular:

- the need for the further development and use of practical tools and methods to support response efforts, as well as for preparedness for, and clean-up of, chemical accidents; and

- the importance of extracting useful insights from experience including past accidents, near misses and exercises, and sharing the lessons learned broadly among interested parties.

5. These Conclusions and Recommendations focus on those aspects of the Workshop that addressed new developments in the area of preparedness and response and, in particular, subjects that were not included in the 1992 *OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response*. The Workshop participants made clear that the discussions should be put into context specifically recognising that it is better, and more cost effective, to prevent accidents; however, this Workshop focused on preparedness and response.

A. Risk Assessment

6. Risk assessment was recognised as an important component for decision-making by industry and public authorities with respect to chemical accident prevention, emergency planning and response, and training, as well as for clean-up and restoration. The Workshop highlighted the considerable effort during the past several years in developing tools and methodologies for assessing risks, in particular for use in connection with emergency preparedness and response. In this regard, the Workshop noted that:

- The nature of the assessment process varies depending on a number of factors including the data available and the objective of the risk assessment (e.g., planning, immediate response, etc.).

- The Workshop identified, in particular, new developments with respect to the use of rapid assessment methodologies for response as well as the use of risk assessment for clean-up/restoration.

- The Workshop took note of the need for joint risk assessments at an international level where there is the possibility of transboundary effects in the event of an accident.

7. The Workshop recommended the use of integrated risk assessment at the local level, by industry and public authorities, for purposes of emergency planning and response and training. Integrated risk assessment provides significant benefits in terms of understanding the true nature of the risks involved. It also helps to define the nature and level of services needed and to involve the appropriate players in the planning and response process.

8. The Workshop addressed the special role of insurance companies within the context of assessing, and helping to reduce, the risks of chemical accidents.

- In particular, representatives of insurance companies can work with operators to review the risks at a hazardous installation and to provide independent advice related to management, organisation and technology at the installation based on their experience.

- Furthermore, insurance companies can provide economic incentives for safety improvements (e.g., by adjusting premiums based on levels of risk).

- It is important to recognise that ”acceptable risk” from the perspective of an insurance company may not be consistent with the level of risk which is acceptable from the perspective of preventing adverse affects to health and the environment from accidental releases of hazardous substances.

9. In order to benefit from the practical experience that insurance companies have gained world-wide from major accidents, and the use of this experience in issuing policies related to hazardous installations, the OECD Working Group on Chemical Accidents should strive to work more closely with the insurance industry and, specifically, to co-operate in the development of guidance and to facilitate the sharing of experience.

B. New Technologies and Information Systems

10. Workshop participants took note of a number of new tools to aid decision-makers (private and public sector) in emergency planning and in response. In particular, they focused on a number of recent initiatives to develop software that permits modelling and mapping of accident scenarios in order to be able to identify potential consequences of accidental releases of hazardous substances. (A number of systems were described at the Workshop including, for example, SEVEX developed in Belgium, RIB Decision Support System developed in Sweden, and Reliability developed in the Ukraine).

- There were significant differences in approaches among the software, based on a number of factors. These include, for example, the level of sophistication of the system, its intended use, the skills and needs of the users and the different assumptions built into the system (e.g., types of scenarios chosen which might include the worst case, the worst credible case, or the most probable case scenarios).

- These tools can be very sophisticated and require significant time and expertise for their development. However, the important issue for users is not how difficult the system was to develop, but rather how well the system functions relative to its purpose and its ease of use. Furthermore, in choosing among available tools, it is important to also take into account their cost effectiveness.

- Tools designed for response purposes, including computer-based tools, need to take into account the very limited time available for making decisions concerning immediate response, and the level of training of potential users. Therefore, systems designed for such purposes must be user-friendly and provide practical information very quickly ”on the spot”, with the input of limited accident-specific data generally available during the initial phases of an accident.

- On the other hand, for preparedness and training, the user has a greater amount of time available and the ability to supply more expansive input. The user also needs more detailed and precise output. In this case, the tools should aid in the process of planning and modelling by, for example, providing a means to search for optimal planning decisions to protect human health and environment in the event of an accident.

- It should be kept in mind that the new technologies are not a substitute for expert judgement and do not provide a simple answer applicable in all circumstances. Rather, they are tools for use by experts or others trained in their use.

11. The Workshop also discussed new technologies to facilitate accident detection and response including, for example, devices for automatically identifying process failures and automatic alarm and warning systems.

- The Workshop participants recognised that the success of the new technologies, even if well-designed and operating properly, is dependent upon the training of the target audience in the effective use of these technologies.

12. In light of the needs identified by the response community for better practical guidance, information systems and other tools to support their decisions, the international community should make a concerted effort to work together to develop these tools.

- **In particular, the Workshop recommended that there should be further co-operation in the development and application of computer-based tools and other new technologies related to chemical accident prevention, preparedness, response and clean-up in order to share experiences, improve the quality of the tools, increase efficiency and minimise duplication of effort.**

- **Furthermore, use should be made of practical experience derived from near misses, past accidents, testing/exercises, modelling activities, and related research activities.**

- **In addition, there should be improved efforts at technology transfer in order that developing countries, and countries in economic transition, have access to the tools and other technologies to improve accident prevention, preparedness and response.**

13. There is a need for internationally-agreed data on acute exposure levels to guide preparedness planning, risk communication, accident response and follow-up actions. Therefore, the Workshop recommended that the OECD Working Group on Chemical Accidents continues its efforts towards the further development, validation and international acceptance of "AEGLs" (i.e., Acute Exposure Guideline Levels), as initiated by the U.S.

C. Emergency Planning

14. It is generally agreed that the planning process for emergencies should involve all relevant stakeholders including all interested authorities at different levels, industry and all organisations that might be involved in the response process (fire officials, police, medical personnel, public works agencies, etc.).

- Such an inclusive process is critical to the success of emergency planning and for well-co-ordinated response efforts.

- It is important to recognise, and address, potential difficulties that might be encountered. For example, the number of agencies involved may lead to additional bureaucratic burdens, concerns about resource allocation, disagreements over division of responsibilities, the need to take account of different cultures and related problems.

- The Workshop also focussed on the importance of involving the public as an active partner in the emergency planning process. This allows the public to have "ownership" of the approach used. Therefore, they will more likely take appropriate actions in the event on an emergency.

- It was recognised that the approach used in the planning process, and in the response to major accidents, differs in different countries (e.g., with respect to the role of national authorities).

15. The Workshop recognised the difficulty in maintaining the skills (and equipment) needed to respond in the event of major chemical accidents since they are relatively rare occurrences. Therefore, preparedness plans should, to the extent possible, assign duties to response personnel which are consistent with (or related to) their regular, day-to-day responsibilities.

16. The Workshop recognised various reasons why emergency plans, although theoretically sound, fail in their application.

- Such reasons could include, for example: not taking account of the lack of information available at the time of an incident; the use of unrealistic or inappropriate scenarios in the planning process; insufficient training (and maintenance of skills) for all parties or the failure to recognise limitations of individuals in stressful situations; and the attempt to utilise a plan which is too complex or places too many demands on certain individuals.

- Furthermore, it is important to recognise that emergency planning should be a process, allowing flexibility in response to take into account the particular circumstances of the accident.

- It is also critical that off-site and on-site preparedness plans in an area are co-ordinated and that responders (including those at hazardous installations and local authorities) consult during the planning and testing process to ensure appropriate co-ordination of efforts in the event of an accident.

- In addition, the Workshop recognised that it is critical to ensure that the identified command centres and first responders are located where they are not likely to be put out of commission in the event of an accident.

17. The Workshop discussed the value of utilising “integrated emergency management”, including a standardised approach for response for all types of natural and industrial accidents, including accidents involving the transport of dangerous goods.

- It should involve the same integrated command structure, applicable for different types of accidents, with a clear distribution of tasks and responsibilities. This helps to address potential problems related to, e.g., differences in language and terminology, potential jurisdictional disputes among the various concerned agencies, and shortages of resources for an appropriate response action.

- An integrated command structure provides a means to facilitate inter-agency liaison. It also provides a means to facilitate sharing of costs and other resources.

18. Regular testing of emergency plans is critical for ensuring that they are adequate, complete and realistic. Testing also provides a means to identify gaps or needs with respect to the availability of appropriate personnel (including training needs), equipment, supplies and information.

- There is a range of testing approaches from table-top to full-scale live exercises; testing through exercises provides a means of building capabilities and confidence of the parties concerned.

- There is a need to determine an appropriate testing regime, and the aspects that need to be tested at a given time (since not all aspects of a plan will be subjected to each test). For example, priority may be given to testing those areas that are suspect or those that have not been tested for some time.

- Those who will be involved in the event of an accident should be involved in the tests/exercises. For example, since a response to a major accident would require decision-making by high level officials (in industry and the public sector), those officials should be involved in relevant tests.

- Maximum benefit is gained from conducting exercises/tests in a "no blame culture", so that all participants can be open and honest in their evaluations.

- If the activity involved in an exercise/test might raise questions or concerns on the part of the public, they should be told about the exercise/test in advance.

- For testing of off-site plans, consideration should be given to combined testing of plans for a given area (i.e., where there is more than one hazardous installation in the area, or where an accident may affect more than one community within a country or across the border). This is more cost-efficient and can provide improved insights into any limitations in the planning.

- The tests should also address the possibilities of accidents involving the transport of dangerous goods, taking into account potential difficulties such as the lack of information concerning the product being transported and the possibility of an accident occurring in highly populated areas.

19. Emergency plans should be regularly reviewed and updated, and should be revised in light of lessons learned from tests/exercises as well as from their application during accidents and near-misses.

20. All relevant stakeholders, including industry, local authorities, and representatives of the public, should be part of the emergency planning process. Information should be made available to permit effective participation of each of the stakeholders.

21. Communities should undertake to achieve integrated emergency management, which addresses various risks (natural and man-made) at the local level. This should be reflected in co-ordination and consistency among all relevant emergency plans in the area and a co-ordinated command structure.

22. The results of testing of emergency plans should be published and made widely available to inform all those who may have a role to play in the event of an accident and to provide a means to learn from the experience of others.

23. One area where further guidance is needed by response personnel is how to make decisions at the time of an accident (or a threat of an accident) concerning sheltering in place vs. evacuation. Co-operative work should be undertaken to address this issue.

D. Risk Communication Related to Emergency Planning (i.e., Information Before an Accident Occurs)

24. The Workshop emphasised a number of points for an effective communication scheme including:

- there is no ”one-size-fits-all” approach to risk communication that is effective is all communities. It is important to take into account the local context including culture, nature of risks, level of awareness, nature of concerns, etc.;

- there are, however, some features that should be common to all approaches. For example, there should be an opportunity for ”two-way” communication, in order that the public is not only provided with information concerning the nature of the risks and what to do in the event of an accident but also has the opportunity to comment and ask questions;

- messages should generally be simple and conveyed using language and terminology that is meaningful to the audience, in order to be better understood and appreciated. While it is difficult to explain concepts such as ”worst case scenarios” based on credible situations, it can be helped by putting the information into a familiar context or by using explanations that are realistic to the target audience;

- despite difficulties in developing appropriate messages, the ability of the public to understand or appreciate technical information should not be underestimated;

- companies should recognise that benign noises, smells, or flares that the public does not expect can raise concerns or questions in the community. Therefore information should be provided to the public about these events and the fact that they do not create any risks. Not doing so can lead to distrust of the company and even the perception on the part of the community that the company is the source of health-related symptoms;

- in defining the target audience for a risk communication scheme, it is necessary to consider those potentially affected in the event of any accident, including people nearby in another municipality or country, and any transient populations; and

- it is important to ensure that messages given in different municipalities are co-ordinated in order to avoid the release of conflicting messages.

25. In light of the efforts to improve understanding of how to communicate risks to the public in an effective way (so that the public will understand and remember messages, take appropriate action in the event of an emergency and participate more effectively in decision-making processes), the OECD should undertake to:

- **collect information on relevant research projects and related activities;**

- **facilitate the sharing of this experience; and**

- **develop further guidance in this area.**

E. Emergency Response

26. Immediate response to an accident involving hazardous substances tends to be primarily driven by the need to protect people (with respect to safety of those at or near the source as well as the protection of response personnel). However, the Workshop recognised the need to also take account of the possible delayed or long-term effects on human health (direct and indirect) and possible environmental impacts.

27. In the initial phases of a response to an accident involving hazardous substances, there is a need to make rapid decisions without sufficient information or time to make a careful analysis of the possible consequences.

- Therefore, it is necessary to make a crude assessment based on available guidance and expertise, as well as incomplete data.

- As time progresses, additional, more accurate information and further expertise become available, allowing for improved decision-making.

- Guidance should be available to emergency responders concerning the levels of acute exposure to various hazardous substances, likely adverse effects, and methods for protecting against such effects. The ”AEGLs”, described in paragraph 13 above, can provide such guidance.

- The more serious the accident, the more likely there will be a need for involvement from outside the community. To the extent that the accidents may have adverse effects on the public, some countries have an established infrastructure to involve regional or national authorities in the response.

28. Despite the natural inclination (and outside pressures) to take action during an emergency and in follow-up activities for restoration and clean-up, it is important to recognise that, on some occasions, the most effective action is an affirmative decision to limit intervention by responders (sometimes referred to as “no action” option). This approach is taken when there is a decision that there will be fewer adverse effects if there is no intervention by responders.

- For example, there may be fewer health and environmental consequences from letting pesticide products burn than by putting the fire out (which would contaminate soil and watercourses). Likewise, it may be preferable to allow an area contaminated in an oil spill to naturally recover rather than use combative methods that may cause additional environmental damage.

- However, a ”no action” option still requires that appropriate monitoring and follow-up be undertaken after the accident to ensure that consequences are recognised and actions, where needed, are undertaken.

29. It is critical to get credible information to the public as soon as possible after the accident.

- There should be a clearly identified, and well-trained, spokesperson to avoid inaccurate or different messages being sent out.

- Where it is not clear that an incident may adversely affect the public, there should be specific triggers when to inform the public about possible adverse consequences or disturbing events.

- There should be a clear, effective and well-publicised source for the public to get information in the event of an industrial accident (e.g., specific telephone number to obtain information, which differs from the number to report emergencies).

30. During the response, there is a need to record decisions and actions taken, in order to be able to be able to review the effectiveness of the intervention, to have input into a formal inquiry, and to learn lessons for future response activities.

31. Further action should be taken to inform and educate the public and policymakers, as well as other stakeholders, about the "no action option" (i.e., that in some circumstances this may be the best option for protecting health and the environment) in order to avoid public or political pressure to take a more detrimental approach.

32. Further efforts should be undertaken to develop and/or share user-friendly response guidance (e.g., the joint effort to develop the "TOKEVA Instructions"), as well as share experience with respect to technical, organisational, and administrative measures for improving immediate response capability.

33. Neighbouring communities (within a country or across borders) should undertake to pool resources (including equipment, expertise and information) in order to make best use of response capacities.

- **In this regard, successful examples were described for establishing pre-positioned stockpiles of specialised response equipment to permit easy and rapid access and deployment.**

- **Even with the pooling of resources, it is important for communities to maintain a minimum level of response capacity (relative to the risks in the community), and retain a level of response resources commensurate with the local risks before sending resources as part of a mutual assistance effort.**

F. Investigating and Reporting Accidents and Near-Misses

34. The Workshop underlined the importance of investigating and reporting not only significant accidents but also important "near-misses," and making these experiences known to anyone who could benefit from the insights gained from such investigations and reports.

- In investigating accidents and near misses, there is a need to determine the "root causes" and not just the initiating events associated with the accidents/near misses.

- Choices need to be made concerning which accidents (and near misses) should be subject to investigations. To do this, there should be a determination concerning which might lead to the most beneficial results in terms of lessons to be learned.

- An investigation should be a fact-finding, not a fault-finding, exercise. Those involved should be reassured that the purpose of the exercise is not to assess blame or allocate liability but rather to gather information in order to learn from the experience.

- The operator of the hazardous installation where the accident or near-miss occurred should be involved in any investigation.

- Investigations (either internal or by a third party) should involve those with the authority to take any corrective actions identified by the investigation.

- In addition, to the extent that authorities are involved, they should develop ways to ensure that they are objective and separate their investigative from their enforcement roles. This might involve, for example, the review of their reports by a third party.

- Often there are several bodies with the authority to investigate accidents. Efforts should be made to co-ordinate any investigations to avoid duplication and improve their effectiveness.

- It is important to recognise that it may not be enough to simply share "lessons learned" since they are not always implemented in practice. Therefore, there is a need to understand how to communicate the information in such a way that it will result in appropriate actions being taken.

35. Operators should be required to report major accidents to the competent authorities, and be encouraged to report significant near misses. The authorities should, in turn, analyse the reports and disseminate information broadly on lessons learned. This could be done in a number of different ways including through electronic means (e.g., World Wide Web) and/or through direct discussions at workshops/seminars.

36. Accident reports submitted to authorities (including, for example, the EC/MARS reporting scheme) should include information on the environmental effects of the accidents, as well as human health effects.

37. Lessons learned on prevention, planning and response from investigations of accidents and near-misses should be shared and publicised. This should include a review of the environmental consequences of accidents. To encourage commitment to publicise lessons learned, information and experiences should be anonymous, if necessary.

38. There should be improved sharing of experience on the methodologies and approaches used in investigations to determine root causes. In this regard, there is an OECD initiative, which has begun by surveying national approaches.

G. Follow-Up to an Accident

39. After a significant accident, appropriate epidemiological protocols and sampling methods should be defined and applied, in order to characterise the accident and to help limit the adverse consequences for human health and the environment and to learn from the accident experience.

- To improve the value of any monitoring/sampling, there should be certain information available concerning the immediate environment and population before an accident (such as background levels of exposure and the nature of the local ecosystems.) This information may be available in a Safety Report prepared by the operator of a hazardous installation.

- There should also be a structured approach to monitoring and sampling to ensure quality of data collection and analysis and provide a basis for comparison over time and between events.

40. The degree of clean-up and rehabilitation which is undertaken after an accident should be decided on a case-by case basis, taking into account a number of factors including: the background level of

contamination; future use of the area; the costs involved; technical capabilities; and the nature of the ecological systems affected.

41. An international initiative should be undertaken to review accident reports available in existing databases to help determine the effectiveness of different response actions and to improve understanding of the causes of accidents.

H. Transboundary Issues

42. Progress has been made in the ratification and implementation of the UN/ECE Convention on the Transboundary Effects of Industrial Accidents ("the Convention"), through bilateral and multilateral agreements, including the "COMPROTEX '99" process.

43. Co-operation between accident-related programmes under international agreements, and within international organisations and institutions, is a key element in achieving further progress in the prevention of, preparedness for, and response to industrial accidents. Specific examples were noted within the UN/ECE region. The active involvement of industry, including industrial organisations such as CEFIC, in these activities will provide practical examples of preventive measures.

44. Transboundary co-operation, including preparedness planning, industrial accident notification and mutual assistance is important to prompt communication and mitigation of the transboundary effects of accidents. In this regard, reference was made to the value of using the UN/ECE Accident Notification System. It was noted that there has been significant experience in the field of marine accidents with respect to such notification systems. Furthermore, examples of bilateral and regional co-operation were described, including the Joint German-Polish activities along their common border.

45. In addition to the conclusions related to transboundary issues above (such as paragraphs 12 and 33), countries, as appropriate, should undertake to:

- **use the UN/ECE accident notification system for industrial accident notification and mutual assistance at the local level in the event of an emergency under the Convention and other bilateral and unilateral agreements in the UN/ECE region;**

- **establish points of contact for the purpose of implementation of the Convention and bilateral agreements, industrial accident notification, accident response and mutual assistance at national level. While these points of contact may be in different authorities, there should be co-ordination among the relevant individuals and authorities;**

- **co-ordinate with neighbouring communities in preparedness planning and response, for an effective response to accidents in the event of an accident with transboundary effects;**

- **develop a procedure to facilitate the transit of personnel and public and private equipment for mutual assistance through the territory of neighbouring countries in the event of an industrial accident (in accordance with Article 12 and Annex 10 of the Convention);**

- **strengthen co-operation to implement common provisions of the Convention on the Transboundary Effects of Industrial Accidents, and the Convention on the Protection**

and Use of Transboundary Water-courses and International Lakes, including the development of a long-term programme for such co-operation; and

- **involve the UN/ECE Regional Coordinating Centre for Industrial Accident Training and Exercises (Warsaw) and the UN/ECE Regional Coordinating Centre for the Prevention of Industrial Accidents (Budapest) in appropriate activities including collection and dissemination of relevant information and the preparation and of, and participation in, COMPROTEX '99.**

ANNEX 1

OECD WORKSHOP ON NEW DEVELOPMENTS IN CHEMICAL EMERGENCY PREPAREDNESS AND RESPONSE

Lappeenranta, Finland

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DISCUSSION DOCUMENT

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The opinions expressed in this document do not necessarily represent the opinion of the OECD or its Member countries and should, therefore, be viewed as solely those of the authors

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INTRODUCTION

The first draft of this Document was prepared to facilitate discussions at the OECD Workshop on New Developments in Chemical Emergency Preparedness and Response. It has been subsequently revised to, *inter alia*, take into account comments at the Workshop.

One of the primary objectives of the Workshop was to review major developments during the past decade, with the aim of reaching conclusions and recommendations concerning best technical and managerial practice in the area of chemical emergency preparedness and response. These conclusions and recommendations should also identify areas where further research or other action is needed on a national or international basis.

The Workshop was also designed to facilitate implementation of the UN/ECE Convention on Transboundary Effects of Industrial Accidents, as well as national and regional requirements concerning preparedness and response. In addition, it provides important input into the ongoing review of the *OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response* (copies of this document are available at http://www.oecd.org/ehs/accident.htm). In this regard, the Discussion Document addresses issues related to Section E of the *Guiding Principles.*

I. RISK ASSESSMENT

A. The Use of Risk Assessment for Planning and Response (e.g., in scaling the response)

1. Risk assessment was developed in the 1970s and 1980s to support safety and to raise its level in the process industry and in other similar operations. In the course of time, this proved useful also in other areas while at the same time new uses were found for it to supplement traditional tools, such as risk probability analysis, fault tree analysis and risk identification. Insurance companies have been especially intent on developing methods that they now use for risk assessment. In the late 1980s and increasingly in the 1990s, risk assessment has gained appreciable recognition also in emergency response services. Today, this is used to assess the appropriateness of prevention techniques, materials and equipment, and to help make the right choices.

2. In general, risk assessment and the related management process is composed as follows:

- risk assessment, including risk identification and risk analysis;
- risk management, including risk reduction and minimisation, risk transfer, and risk restraint or controlled retention; and
- financial aspects of risk elimination and reduction, and economic considerations.

3. Can this pattern of thought be adopted into emergency response services as well? In fact, it is very important that the existing risks are identified and that the decisions taken in that respect are well justified and in the interest of society and safety. Emergency response services play an important role in this process. For example, the essential elements of risk management in fire fighting and rescue services are:

- the definition of risk areas;
- the definition of the service level; and
- the preparedness of the operational management.

4. Typically, emergency response services need to be prepared for, and respond to, low probability but high impact incidents. Standard risk analysis procedures involving cost benefit analysis would be expected to place these types of incidents in the low return on investment category. However, impact analysis programs using worst-case scenarios clearly identify emergency response requirements. The impact analysis process examines a set of five variables:

a. Assets – whatever you are trying to protect including populations, property, infrastructure, commercial and industrial resources, environmentally sensitive resources, recreational facilities, food production, farms, etc.

b. Threats – events that could happen at any time, including natural and man-made disasters, vandalism, sabotage, accidents.

c. Vulnerabilities – weaknesses that would allow the threat to materialise, including structural, equipment, processes, organisational, regulatory, planning, policies, reliability and training.

d. Losses – if the threat occurs, what kind of impacts would be experienced, including loss of resources, access to life sustaining facilities, i.e., food and water supplies, work locations, hospitals, transportation networks and sustainability of environmentally sensitive resources.

e. Response Actions – what regulations, policies, procedures, organisations, resources could be established to prepare for and respond to a worst case scenario.

B. Planning

5. Emergency plans and the definition of service levels should be based on a risk assessment made by emergency response professionals and founded on companies' documents and reports including safety reports, construction plans, flow diagrams, piping plans, material lists as well as internal emergency plans (based on, e.g., EC Directive 96/82/EC, Article, 9 and 11, or national or local requirements).

6. In addition to large companies, the risk assessment of emergency response services should address, with special attention, those companies and establishments, including small and medium-sized enterprises (SMEs), which handle, produce or store dangerous substances in a quantity smaller than the threshold value specified in the regulations. Large companies often make safety reports voluntarily or in compliance with the regulations while smaller companies which are not subject to the regulations often fail to do so. Furthermore, these smaller establishments are more likely to be located near populated areas. The result is that SMEs present a real challenge to society and to public emergency response services.

7. The risk assessment of emergency response services should consider the following points:

- The risk assessment should point out potential major risks and respective restrictive measures.
- Useful methods of analysis include, for instance, the hazard and operability study (Hazop), the human error analysis, the "what if" analysis and the reaction matrix.
- The probability of single incidents or chains of incidents may be reviewed by quantitative methods, such as the applied fault tree analysis and the cause and effect chart.
- On the basis of these analyses, the risk assessment of emergency response services can give insight into the appropriateness of the available equipment and techniques for the risks involved.

8. Existing emergency plans should be reviewed on the basis of potential risks and, for example, the following details should be cleared up:

* Are the personnel resources adequate for potential risks?
* Is the equipment appropriate and sufficient to deal with foreseeable events?
* Are supplemental equipment and personnel available and where?

C. Response

9. While qualitative and quantitative risk and impact analyses, both internal within the company facilities and external within the affected community, help define the internal and external emergency

response plans, qualitative risk analyses is used almost exclusively during the actual response. However, essentially real time trajectory models for both air and water dispersion of contaminants can be incorporated into response operation and planning activities during the event. Air dispersion models exist which predict contaminant concentrations downwind from the source and are very helpful in identifying areas of impact requiring response efforts. Risk and impact analyses activities also identify assets at risk which, when incorporated into emergency response plans, help prioritise response activities. For example, elder care facilities, hospitals, critical infrastructures and environmentally sensitive resources might require immediate response attention and therefore need to be pre-identified in the appropriate emergency response plans.

10. Appendix 1 reviews briefly how risk assessment has been used in rescue services and environmental accidents in the EU member states and in Norway.

II. PREPAREDNESS/CONTINGENCY PLANNING

A. Developing Preparedness Programmes and Plans

(**The role of the stakeholders (authorities at different levels, industry, labour, insurance companies, public sector)**

11. For years, emergency response planning has been part of preparedness activities, from daily emergencies to major disasters and crises. Companies have traditionally produced their own plans while governments have provided the so-called external plans. From a management perspective, planning is a top-down process beginning with broad strategic goals at the highest level of the organisation or government and proceeding through tactical objectives at the mid level to detailed operational requirements at the local or field level.

12. Within governments, national laws produce implementing regulations that result in a plan specifying overall planning goals and requirements to be implemented at the regional and local level. The regional plans establish requirements to be implemented within a specific geographic area taking into account characteristics of that area. The local governmental plans detail the specific state, province, municipality objectives and include details concerning resources, priorities for protection, sensitive areas, response times, infrastructure, and major potential hazards to be dealt with such as flood, extreme weather, fire, explosion, earthquake, industrial accident, etc. It is also at the local level that government plans address multiple requirements such as potential competition for response resources in a very large incident, or the potential impact on neighbouring industrial facilities from a single plant incident.

13. Governmental plans draw together diverse resources such as air, water and soil pollution experts, nuclear radiation skills, environmental specialists, public and traffic control authorities and public access to evacuation facilities. Additionally, government plans address and resolve divergent views concerning response priorities, cleanup actions, and “how clean is clean” decisions.

14. Corporate plans are specific to a particular company and address that company’s policy and procedures. At the local level, a company’s on-site emergency response plan must meet the local government plan requirements in terms of resources, organisation, training, notifications, alarms, co-ordination, response times, etc. A major effort in many countries is directed at integrating numerous planning requirements imposed by various governmental agencies. A single company located, for

example, in a port could be required to prepare marine and land spill plans, air, water and soil discharge plans, and tank, pipeline, truck and rail transportation plans. It is advantageous, wherever possible, to integrate the planning process to minimise duplication and overlapping responsibilities as well as make the best use of limited personnel and response resources. Lastly, emergency response training can be more clearly focused on those individuals responsible for emergencies.

15 An "incident command structure" ensures communication and co-ordination among authorities, the public and the responsible party. Typically this structure is composed of an incident commander and the command staff including public relations, legal, safety and deputy commander. Reporting to the command are the operations, planning, logistics and finance groups. The primary focus of these groups is:

- Command – Overall strategic objectives for response, co-ordination of all interests.
- Operations – Tactical response and incident cleanup activities. Operational control of people and equipment.
- Planning Documentation, action plans, display of response status, briefing documents.
- Logistics Acquisition, tracking, staging and demobilisation of equipment and supplies.
- Finance – Cost tracking, documentation and projections.

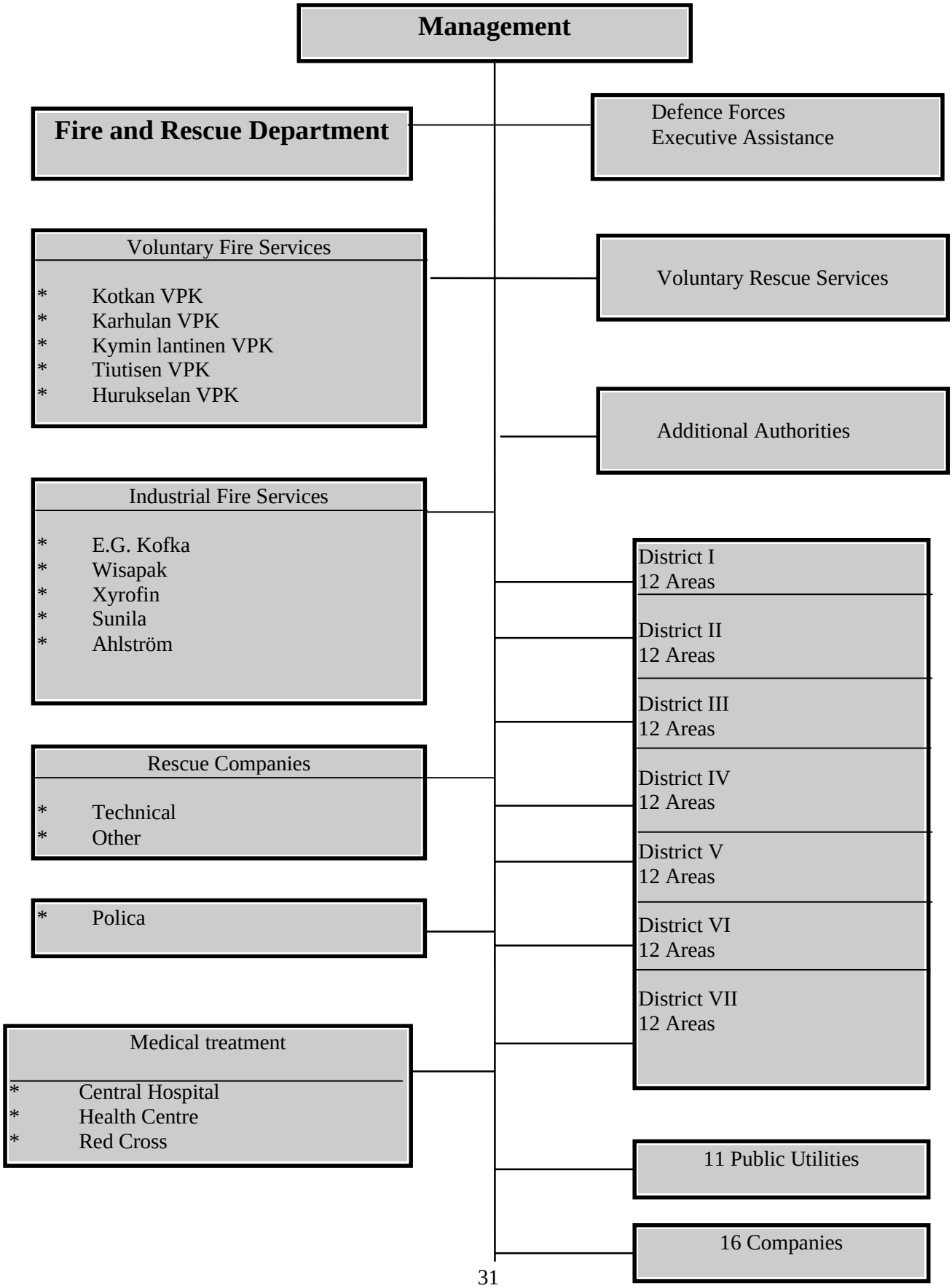
16. For one example, the United States Coast Guard Oil Spill Field Operations Guide, ICS-OS-420-1, June 1996, presents detailed discussions of the Incident Command Structure including subgroups of these five functional areas. Copies of this guide can be downloaded from the following web site:

<www.uscg.mil/hq/g-m/nmc/respond/index.htm>

17. The emergency event itself determines the degree to which the organisation is activated and includes consideration of magnitude of release, geographical area involved, populations at risk, resources at risk, impact on commerce and industry, and ability of local jurisdiction to handle the response. Past events, drills, and exercises, if properly documented, serve as models for future planning activities. These scenarios provide the basis upon which decisions concerning resource needs, acceptable response times, potential areas of impact and priorities for protection and response can be made.

18. Figure 1 on the following page shows the civil defence and rescue service organisation of the City of Kotka. This organisation can be called up in the event of accidents under normal conditions and the rescue operations are directed by the fire authority.

Figure 1: Rescue Service Organisation



19. Civil defence and rescue services are integrated in Finland, i.e., the same authority is responsible for both.

- The depicted municipality is divided into seven districts and these again into smaller areas. Properly trained civilians are in charge of the districts.

- The police and the defence forces as well as other co-operating authorities contribute to rescue operations as prescribed by various regulations.

- The City Fire Department, voluntary fire services and industrial fire services are subordinated to the fire chief. Industrial fire services are used, provided that the industrial plant's safety is not jeopardised.

20. Contingency plans are live documents in that they must be continually updated and modified. On-site plans are modified when organisational changes dictate new roles and responsibilities for the company emergency response teams. Updates are also called for when production modifications or additions/deletions to product lines result in changes to the source of potential risks. Finally plan changes are recommended when advances in the state of the art in emergency response produce more effective protective actions.

21. It is important for emergency planning that all authorities and emergency response organisations take an active part in the entire planning process. The governmental authorities take the lead in ensuring the participation of all necessary resources based on the needs expressed in the governing documents. Such resources could potentially include, for example, police, border authorities, social welfare agencies, health authorities, environmental organisations, public advocacy groups, and the Red Cross/ Red Crescent.

22. The question of monitoring and personnel protective equipment (ppe) must be addressed during the planning process. Some countries have strict regulations concerning training requirements prior to the use of certain ppe, such as respirators and self-contained breathing apparatus (SCBA). However, the over-riding discussion should be directed at the various roles of individuals and organisations and their need to use and wear ppe. For example, first responders defined as police and ambulance teams need to be trained in hazard recognition and area isolation/evacuation techniques and do not usually put themselves in atmospheres requiring ppe. The use of this equipment should be limited to those teams who have received the proper training in the ppe use, maintenance, checking out and limitations. This is to prevent accidental injury by well meaning individuals who might, for example, select a respirator canister type breathing apparatus when in fact oxygen displacement has occurred and the use of an SCBA is needed. Therefore, the roles of team participants need to be defined before decisions concerning ppe are made.

23. Once ppe decisions are made, discussions concerning acquisition can follow. It is important to include storage, maintenance, repair, upgrading, training, certifications, licensing, special tools, and ancillary resources such as compressed air in these discussions as owning ppe brings these additional responsibilities.

24. It may be necessary for ambulance crews to be equipped for the treatment of people; for example, they may have long gloves to protect against chemicals as well as ppe. The following example illustrates a case where these personnel would need such protective equipment. An industrial accident occurs in which there is a risk that an employee gets spattered with a chemical. If the accident occurs outdoors at a low temperature and the chemical does not evaporate or gasify sufficiently, and if the patient is contaminated and has not been decontaminated before he/she is taken to the ambulance, once in a warm place such as

inside the ambulance, the chemical begins to evaporate to an extent which is hazardous exposing the ambulance crew.

25. The emergency plans of hospitals may be required to provide for contaminated patients or transport units. Therefore special premises have to be planned and prepared, in advance, in close vicinity to the emergency care unit where people who have been exposed to chemicals, radioactive fallout or biological substances, can be received and decontaminated safely.

26. Once the roles and responsibilities for the participants in the emergency response team have been defined and clearly understood, it is the responsibility of these participants to be prepared to respond within their own area of expertise. The following paragraphs describe two scenarios, chemical exposure requiring treatment and transportation of hazardous goods, which exemplify these responsibilities. It should be noted that authorities and jurisdictions vary from country to country. However, response functions need to be carried out albeit by different organisational entities.

27. Industrial operators must, jointly with the rescue authorities, be in contact with public health authorities if the chemicals or gases to be treated are such that an exposed patient must be treated with special medicines or methods that cannot be assumed to be available in local hospitals. It is then necessary to consider whether such medicines should be purchased for industrial plants and transport vehicles, or whether it is sufficient to ensure that they are available in local hospitals.

28. One such dangerous substance is sodium cyanide, UN 1689, which is used for gold dressing. This chemical may be loaded and unloaded at ports and transported to an end-user in the same country or in a different country. The end user may know how to proceed in case of an accident but the rest of the handling and transport chain and the rescue authorities do not necessarily know how to take care of a person exposed to this substance.

29. Exposed persons must immediately receive special medicines, amyl nitrite tablets and a 1 per cent solution of sodium thio sulphate. As an example, these medicines had to be ordered specially for the transport of the above-mentioned substance in the south of Finland in the mid 1990s. The medicines were packed in a kit that was sent to the port for the duration of the ship's unloading. When the sodium cyanide was loaded on to railway wagons, the kit was given to the engine drivers for use in the event of an accident en route. The train was met at the Finnish border by a locomotive from the neighbouring country and the wagons were coupled up. The medicine kit was not handed over. It was brought back from the border with the Finnish locomotive and taken to the port to await the next transport.

30. The European Union has addressed the issue of emergency planning in the so-called "Seveso Directive". While the Seveso II Directive (96/82/EC) excludes the transport and temporary storage of dangerous substances by road, rail, internal waterways, sea or air (Section C of Article 4), transport of dangerous goods is an essential part of contingency planning and should be taken into account in the authorities' external emergency plans.

B. Integration of On-site and Off-site Plans (avoiding redundancies)

31. Internal and external plans must be harmonised to avoid confusion, identify clear lines of responsibility and authority, clarify expectations, and minimise duplication. Additionally, emergency responses must be initiated without delay, which necessitates clear organisational duties. Realistic accident models, based on local transportation, production, or storage facilities provide for a common set of circumstances around which internal and external plans can be built, evaluated, modified and revised.

32. It is usually the responsibility of the local government or municipality to ensure that internal and external plans are consistent and realistic for the geographical area involved. This may be accomplished by regulation, certification or licensing requirements. Testing, as discussed later, is also an effective means to ensure compatibility of response plans. Usually, the government or municipal plans identify response requirements in terms of overall guidance. Then it is up to the company plans to address how these requirements will be met at the particular facility, transportation network or storage unit. Again, variation exists between and among countries. Therefore, it is necessary to maintain open communication with all stakeholders and develop clear requirements and responsibilities for the geographic area involved.

33. According to Annex IV to the Seveso II Directive, internal and external emergency plans must indicate:

- the names and positions of the persons who have the authority to launch rescue operations and who are responsible for the establishment's on-site rescue services;
- the names and duties of the persons who have the authority to launch rescue operations; and
- the names of the persons who have the authority to lead and co-ordinate off-site operations.

34. The authority to launch rescue operations should not be given to designated persons but it should be attached to certain posts. Appropriate echeloning and deputation top-down within the emergency response service will ensure that operations are launched without delay. The point is that if the authority to launch operations is given to a designated person it may, in fact, slow down the launching of extended services if the specified persons cannot be reached. Furthermore, there is a large turnover of people especially in the industry and therefore any authority given to a designated person may soon be out-of-date.

C. Review and Revision Of Plans

The need to incorporate the latest developments

35. Where there is a licensing requirement, operators who handle and store dangerous substances have set up emergency response organisations and adopted techniques that were appropriate at the time they applied for their operating licences. However, over time, additional or more precise specifications may have been developed , for example as a result of accidents.

36. The authorities and/or licence issuers should in their annual or periodic inspections explain to the operators the effective emergency response level required of a new similar establishment and record in the inspection protocol minimum modifications which the operator should make, provided that the existing plant or storage operator is subject to the revised regulations applicable to new operations.

Testing of the plans (cost effectiveness, stakeholders' responsibilities)

37. There should be regular drills and exercises to test both on-site and off-site plans. These should be done according to advance programmes and timetables.

38. One useful method for testing the compatibility and effectiveness of plans is to use accident scenarios. This usually follows a *directed free play approach* in which a "control team" initiates the drill or exercise with an explanation of the emergency event and the "response team" carries out its duties as required by the appropriate contingency plans and the event particulars. As the response unfolds, new

updates are provided by the control team, such as the movement of a toxic plume, the impact on affected populations, disruptions due to conflicting demands on the team members, requirements for public meetings or media aggressiveness. These exercises can include notification drills following alarms, assembly of appropriate response team members, establishing communications, developing action plans, conducting response planning meetings, preparing documentation, conducting media briefings and public meetings, and launching of response resources.

39. It is important that the exercise be as realistic as possible in order to accurately evaluate the "response team's" effectiveness. An "evaluation team" is usually employed to conduct an after exercise debriefing and capture those actions and items that worked well and those that need additional improvement. Participation by company and government representatives is encouraged as well as observers from companies and organisations not directly involved in the exercise. This increases the cost effectiveness of the exercise by reaching as many in the community as possible. All are encouraged to participate in the after action debriefing so as to capture all positive recommendations.

40. Drills and exercises can be expensive. Notification exercises, that require verification of callout procedures, simply use phones and call trees and do not require actual movement of resources. These involve minimal costs and usually last less then one hour. Table-top exercises can be more elaborate but do not involve the deployment of field resources. They require movement of response team management employees to a pre-selected command post and can last from four to 48 hours. All stakeholders should have representatives at these table-top exercises including regulatory authorities as well as the company team members. Finally, hands-on drills involve the deployment of field teams, response equipment as well as the command post management teams. These drills can last from 12 to 48 hours, not including mobilisation and demobilisation of equipment. Table-top and hands-on drills require detailed planning taking up to 9 months for a comprehensive exercise. Additionally, it behoves the sponsoring entity to capture as much useful information as possible due to the time and effort spent on the drill. Therefore support teams are also involved for evaluations, debriefing and report writing.

41. Drill and exercise frequency vary based on the regulations of the particular country and/or municipal authority. However, the following is one recommended approach for the frequency for each type of exercise:

- Notification Drill – monthly
- Table Top Exercise – annually
- Hands-on Exercise – once every three years

42. Costs associated with conducting drills and exercises are assigned based on the regulations of a particular country or municipality. These costs include the use of consultants for design, management, co-ordination with stakeholders, and report preparation, transportation, housing and feeding of teams, rental of spaces for assembly and audio/visual equipment, mobilisation and demobilisation of equipment, and hiring of temporary support personnel such as security. The following are broad cost ranges in US dollars for these exercises. The range, of course, depends on the duration and extensiveness (people and equipment):

- Notification Drill - $0 - $1,000
- Table Top Exercise - $20,000 - $250,000
- Hands-on Exercise - $50,000 - $500,000

43. Some countries require by regulation that companies conduct and pay for their own exercises. In these cases, participation by personnel from governmental organisations and municipal authorities might be at the sending agencies expense. Some governmental organisations conduct their own drills and exercises. Participation by company personnel is at the companies' expense. Occasionally, authorities and

governmental agencies request a corporate sponsor participate in the government drill and cover pre-agreed expenses. In cases such as this, the sponsoring company should be given credit for the drill in meeting any mandated exercise frequencies.

Application of the information from the inspections

44. The information yielded by inspections or the results of the practical testing of the plans should be compared with the resources of the existing emergency response organisations, to see whether the preparedness capacity meets the existing threats.

45. Once the emergency response arrangements of various companies are at the prescribed level, the emergency response capabilities of municipal services must be brought to the required level. This is done within the municipality or with the assistance of neighbouring municipalities' emergency response authorities. This help should be discussed in advance and it should be based on the municipality's risk assessment, which shows the shortcomings in the municipality's state of preparedness.

D. Stakeholders' Responsibilities

46. Operators of facilities are responsible for the proper functioning of their production, storage and transportation units. They are also responsible for the identification of risks associated with these operations, and the preparation, maintenance and updating of on-site response plans. Finally, they are responsible for identifying and positioning staff and equipment, training and maintaining these resources.

47. Governmental authorities are responsible for enforcing corporate compliance with various emergency response regulations and ensuring that the legitimate needs of all stakeholders are taken into account in the plans and the response planning activities.

48. In addition to merely meeting regulatory requirements, proactive companies have integrated emergency response programmes into their business policies. This raises the level of importance of chemical emergency preparedness and response so that all employees from all business sectors can focus on meeting the programme requirements.

49. One approach to accomplishing this high level of exposure is to incorporate chemical emergency preparedness and response into an ISO/9000 management system. First, a prime tenet of the ISO/9000 standards is that all processes essential to the business be documented (formal procedures) and that records be kept as evidence of certain process activities. This helps the emergency response personnel identify critical functions, as well as risks to be eliminated, reduced or planned for. Second, as part of the Internal Audit and Corrective/Preventive Action requirements of the standards, the process can continually improve the plans and procedures, including reviewing how an emergency would impact the facility and how the company would respond to minimise the internal and external impacts. Third, implementing the ISO/9000 standard approach ensures that management and staff understand the needs and participate in the process.

50. In the United States, CHEMTREC was established in 1971 and is affiliated with the Chemical Manufacturers Association, a not for profit industry trade association. It provides a full complement of services to shippers and carriers of hazardous materials, helping companies to comply with government regulations, while reducing overall risk and promoting responsible attitudes. CHEMTREC maintains an Emergency Call Centre that provides "around the clock" emergency response information in the event of hazardous material accidents. All of the Emergency Service Specialists in the Call Centre receive vigorous training in the hazmat and emergency services field. In addition, many of the technicians have prior experience in the emergency response area, often working as fire fighters, emergency medical technicians

(EMTs), or health care providers. The Emergency Call Centre is a state of the art communications hub that provides information and links chemical experts and resources with emergency responders. The Centre features computer systems and software, including the ability to retrieve in seconds a specific MSDS from its library of over 2.8 million, to link persons at an incident site with the registrant and to document the incident in report form. The Centre features its own power generation and HVAC systems, making the facility self-contained and ensuring round the clock reliability. While all countries might not need such a facility, CHEMTREC defines a responsible commitment by the chemical industry to improving its emergency response capability.

51. One last example of Stakeholder Responsibility is the creation of the Emergency Management Guide For Business & Industry, sponsored by a public-private partnership with the US Federal Emergency Management Agency (FEMA) and 14 industry organisations. The guide provides step-by-step advice on how to create and maintain a comprehensive emergency management program. It can be used by manufacturers, corporate offices, retailers, utilities or any organisation where a sizeable number of people work or gather. Whether operating from a high-rise building or an industrial complex; whether a large or small company; the concepts in this guide will apply. The guide details four steps in the planning process and discusses in detail emergency management considerations such as:

- direction and control;
- communications;
- life safety;
- property protection;
- community outreach;
- recovery and restoration; and
- administration and logistics.

This document can be downloaded from the FEMA web site at: www.FEMA.gov

52. More and more, insurers and insurance brokers are addressing the area of risk management when evaluating vulnerabilities of client companies. Managing the total cost of risk is beginning to include not only emergency response planning programmes, but also insurance policies that consider risk and retained risk. It behoves insurance agencies to minimise the probability of risk and loss carried on its policy and it behoves the client company to minimise the retained risk it must deal with. Working as a team, company and client focus on realistic means of reducing risk, and minimising effects of risks thus reducing the total cost of risk through premium considerations. These saved resources go directly to the companies' bottom line.

E. Personnel

53. The first priority for emergency response is to provide for the safety and health of personnel. The following Safety Plan Checklist, from the US Coast Guard's Field Operations Guide referenced above, can be utilised in any emergency response operations:

a. Assign site safety responsibility
b. Establish activity perimeters and restrict access

c. Characterise area hazards
   - Identify pollutant
   - Obtain Material Safety Data Sheets
   - Conduct air monitoring
   - Identify physical & biological hazards, i.e.: slips, trips, falls, confined spaces, noise, weather conditions, poisonous insects, reptiles, plants, & biological waste

d. Establish control zones
   - Exclusion zone
   - Contamination reduction zone
   - Support zone

e. Assess training requirements and skill levels
   - Check certification cards
   - Insure safety briefings

f. Select personnel protective equipment (PPE)
   - Levels of protection
     - A = total encapsulation with SCBA
     - B = SCBA + chemical resistant rain gear
     - C = Respirator + Chemical resistant rain gear
     - D = Chemical resistant rain gear

g. Establish decontamination stations

h. Create emergency medical plan
   - locate hospitals, EMTs & first aid stations
   - List emergency phone numbers: fire, police, ambulance

54. According to an investigation made by the Finnish Institute for Occupational Health, persons who are doing work that requires chemical-proof apparel and pressure respirators must have a good oxygen uptake (3.5 litres per minute). Additionally, the US Occupational Safety and Health Administration (OSHA) specifies training, maintenance and usage requirements for respirator and SCBA wearers.

55. People should be trained to use pressure respirators and chemical-proof apparel according to the instructions. Pressure respirators and chemical-proof apparel are normal protective equipment and selected workers can be trained for their use. The duties that require such protective apparel may be within the establishment’s normal routines.

56. Since a chemical accident is a sudden incident with many surprise factors, setting special requirements for the emergency response worker, a production worker should not be obliged to do chemical response on the basis of his/her training; these duties should be handled by specially trained emergency response personnel.

57. Accident response personnel's health and physical condition must be monitored annually. It is important to assess whether the production plant's own people can be used for demanding response work, and to evaluate the level of the response personnel's preparedness.

F. Training

58. Training and drilling should be proportional to the risks and threats within the community or municipality. It is important to assess, for example on the basis of the industrial operators' risk assessments, the most probable incidents and plan the drills and training correspondingly.

59. In localities with a considerable risk of chemical accidents, regular chemical training drills should be organised by emergency response authorities. It has been suggested that two such training drills should be held every year, of a type appropriate to local needs (e.g., strategic, tactical, operational). Such drills could address, for example, putting on a chemical-proof suit, setting up a washing and decontamination station for chemical emergency response personnel, washing and cleaning, providing additional supplied air for those who run out of air before washing, setting up a safety extinguishing system and practising communications.

60. In addition, there should be regular practice by personnel of chemical response techniques in accordance with the drill alarm. Again, it has been recommended that this be done at least twice a year in communities with a considerable risk of chemical accidents. This practice could address putting on protective apparel, definition of the protected area and the danger zone, setting up a flushing and washing station and practical response actions.

61. These situational training drills should be carried out jointly with the operators, to also test the functioning of the on-site emergency plan.

62. It is very important for the external emergency response personnel to get to know the companies in its area and their arrangements for response operations, including fire-fighting and prevention, alarm systems, first response, and the location of emergency response materials and equipment. It is also critical that external emergency response personnel learn plant diagrams and the location and data for hazardous materials and chemicals.

63. In international road and rail traffic, hazardous substances being transported are marked according to international agreements which, in the event of an accident, the properly marked transport package or container indicates the type of risk involved. Problems may arise if the transport people and the rescue crew speak different languages. This will naturally delay the launching of appropriate response actions.

64. The transport container may also be marked with letters or graphic characters which differ from those of the country concerned. Emergency responders should be aware of these potential language difficulties.

G. Materials and Equipment

65. Some of the response systems required in the event of accidents involving hazardous substances are ordinary tools and equipment which the operators and companies who transport dangerous substances use every day, i.e., chemical pumps, chemical tanks and containers, respirators and masks, suction hoses, content indicators, etc.

66. Some of the equipment, such as chemical-proof apparel, leak detectors, medical instruments and communications equipment will have to be provided by the emergency response authorities.

67. The emergency response authorities should map out the response equipment available in the municipality for the event of accidents involving dangerous substances, as well as any shortages and deficiencies, for example by means of typified accidents.

68. The quantity and quality of the required response equipment should be evaluated on the basis of the municipality's chemical risks.

69. The equipment needed to respond to chemical accidents should be compatible on the national plane. The quantity and quality of the municipality's prevention equipment should be comparable with those of other municipalities with similar chemical risks (Figure 2 gives the risk-related equipment recommendations of the so-called TOKEVA instructions).

Figure 2 Risk-Related Equipment Recommendations of TOKEVA Instructions

INVENTORY LEVEL 1	INVENTORY LEVEL 2	INVENTORY LEVEL 3	INVENTORY LEVEL 4	SPECIALIST EQUIPMENT
No significant risks	Chemical risks	Large chemical risks (e.g. transportation)	Significant chemical handling areas and Storage sites	1-5 units throughout the country, Special equipment 4 to 8 hours
Duties: Life-saving Rapid limitation of Consequences Warning Evacuation Isolation Reconnaissance	Duties: Chemical rescue Reconnaissance Prevention of spreading Limitation of Consequences Plugging up leaks Recovery/collection First response	Duties: Technical prevention Stopping/plugging up Transfer pumping, Vacuum 3 Transport containers Neutralisation First-Aid station	Duties: Reinforcements Units e.g. for command, medical, cleaning/ decontamination personal protectors, stopping/plugging up, pumps, tanks/containers, Neutralisation, Measurements, Power sources	
Response time: 10 minutes/ 20 minutes	Response time: 20 minutes/ 30 minutes	Response time: 60 minutes/ 90 minutes	Response time: 120 minutes/ 180 minutes	
Protective equipment: Chemical-proof apparel, 3 suits, And/or splash-proof apparel, 4 units Compressed-air units, 5 units Spare bottles	Protective equipment: As under standard 1 plus, Chemical proof apparel, 4 units, Compressed-air units, 10 units, Spare bottles, Filter protectors, 6 units Fire-proof apparel, 2 suits Cold-proof apparel, 3 suits, Dressing facility, Flushing facility	Protective equipment: As under standard 2 plus Chemical-proof apparel, 9 suits, Splash-proof apparel, 6 suits Compressed-air units, 12 units Spare bottles, Filter protectors, 20 units Cold-proof apparel, 3 suits, Heated dressing facility, Cleaning/decontamination station	Protective equipment: As under standard 3 plus, Chemical-proof apparel, 9 suits, Splash-proof apparel, 10 suits, Compressed-air units, 15 units Arrangements for additional air Spare bottles X 3, Filter protectors, 40 units, Fire-proof apparel, 3 suits, Cold-proof apparel, 6 suits Heated dressing facility, Maintenance station,	

70. On the national plane, there should also be heavier/more specialised chemical response equipment which is placed close enough to major risk sites. The people who know how to use this equipment should come to the site of the accident with the equipment.

71. It is important to inspect and test the prevention equipment, permanent systems and alarm systems, at regular intervals, for example during drills and exercises or inspections.

72. The plans must also provide for replenishment and replacement of the response materials.

H. Communications and Information to the Public

73. It is recommended that an establishment invite all the inhabitants of the district to see the plant operations. This, together with the establishment's bulletins, will provide pertinent information also with respect to the measures required in case of an accident.

74. In the event of an accident, the emergency response authorities should ensure internal communications, exchange of information between the different authorities, instructions and information to the exposed population, briefings and meetings with media people, as well as press releases. In addition, the operators involved should provide information about the accident.

75. In the event of an accident, the population must be informed as quickly as possible. If possible, the first bulletin should be prepared jointly with the operator. Even if the operator has distributed information to the public, as per the Seveso Directive, this may not be sufficient, considering the extent of the accident or the dangerous substances involved. Insufficient information may give cause for unnecessary speculations of the gravity of the situation, creating a stir and causing needless worries and fears.

76. In any event, the first news of an accident involving dangerous substances will most probably be passed to the media by eye-witnesses who use, for example, mobile phones. This first information may make the news threshold also on the international plane. If relevant official information is not provided within a few hours of the incident, the "correct" information may be "old" news and will be passed over by the international media, or they may only bring a brief mention of it.

77. False or incorrect information, which is not corrected in time, is likely to cause damage to the companies involved. The emergency response authorities should take this into consideration because, while protecting people and salvaging property, it is also important to protect and save the international reputation of the company by distributing correct information early enough.

78. It is probable that information about a major accident will be distributed by the media concurrently with the launching of the rescue operations. This may cause uncertainty and fears among the people in the immediate neighbourhood. Their families and relatives start making telephone inquiries, congesting telephone services. To avoid this, it is important to distribute proper information about how to behave in case of an accident.

79. Media releases and community outreach activities requires careful co-ordination between the authorities and the responsible company. The needs of the media for details, visuals and deadlines should be accommodated as well as possible, given the constraints of the unfolding situation. Likewise, conflicts between responding entities should be worked out in private, not in the media. It is also important for maintaining public confidence that the responding entities represent a united front concerning strategic and tactical objectives as well as accomplishments. Therefore, all public releases should have the approval of both the authorities as well as the responsible company. Joint press conferences should be held at or near

the command post. Clear, concise presentations should be made under the overall direction of the appointed press officer. This individual needs to control the questioning process and the potential aggressiveness of the reporters. It is highly recommended that for medium and major incidents, professional media agencies be retained for this purpose. Additionally, company and authority spokespeople need to prepare ahead of time for any public or media events, with formal statements, answers to anticipated questions, and desired messages to be transmitted. The spokespeople should not be directly involved in the operation of the incident but have access to these staff if needed. All the individuals from the authorities and responsible company who address the media and/or public need to reflect compassion, technical competence, and a willingness to see it through to the end. At no time should they appear tired, frustrated, overwhelmed, confused or out of control. The purpose is not to manipulate but to maintain control over a potentially dangerous situation.

80. Professional public relations agencies should be employed during an incident to monitor the media releases in the press, TV and radio. In this way subsequent media releases can correct mistaken information, add important facts not yet released and add technical data to clarify the unfolding story.

81. Public meetings during emergency events are usually very difficult to manage and may degrade into one-way shouting matches with nothing accomplished. It can be more effective to create links with smaller public advocacy groups who can then serve to inform their respective constituents. These groups can also provide valuable feedback as to the public's feelings concerning actions taken during the emergency event.

82. Communications plans should address:

- communication tactics;
- distribution of information through professional media people; and
- acquisition of proper equipment for the distribution of information and learning to use them.

83. Communications among emergency response personnel is critical during an event. A communications plan needs to be developed to address specific means of transferring information. This plan should clearly identify the types of communication to be used by the various teams. The plan needs to be in written format and distributed to all involved in the response. VHF radios are commonly used by field personnel. Frequencies or channels need to be clearly identified for operations, logistics, decon, specific zones, etc. Some countries establish emergency response frequencies that are reserved for use only during such events. Repeaters may be required if the terrain interferes with transmission. These requirements can be identified during drills and exercises. Cellular and landline phones are the most common tools for command post to field and command post to outside sources communications. It needs to be remembered that cellular phone usage increases greatly during emergency events and the local capability may experience overload. Training in communication is necessary among stakeholders so that discipline can be maintained during the event.

84. Appropriate communication systems are, for example, the telefax, the Internet, and new gsm communicators which can be used to send text messages and telefaxes, as well as for linkups over the Internet. These communicators are the same size as mobile phones. It is also important to check in advance that these units are compatible with the communication systems of those parties and persons who need to be contacted.

85. In those municipalities which are prone to major chemical accidents, it is important to make advance plans for communication procedures in the event of accidents. Considerations include:

- identification of available communication resources, including equipment and skilled operators; and

- geographical areas where coverage is weak or non-existent and the means to correct this.

I. Command Structure

86. The levels of command must be clear, especially in the case of accidents across municipal boundaries and with regard to co-operation between various public authorities and industries. The same basic command structure should be used for all magnitude of events.

J. Tactical/Operational Manual

87. A number of guidance documents have been issued in different countries for use in the event of accidents involving hazardous substances and chemicals. Some of these documents are internationally known. Some are intended for emergency situations only, while others give specific instructions for different substances, as well as instructions for drills and exercises with respect to accidents involving a variety of substances.

88. International road, air and rail transport organisations have also issued guidance documents for the transport of dangerous substances which are revised and updated, as need be, almost every year.

89. Instructions for the response to chemical accidents should be prepared and imposed in every country. These instructions should address the most commonly used and transported chemicals in each country, as well as the dangerous substances whose handling and transport involve a risk of major accidents. Some of the reasons that such instructions are valuable are:

- The instructions permit harmonisation of the equipment and materials used for the response to chemical accidents in the country.

- The danger of accidents can be assessed more clearly with respect to response services and the required resources can be defined in advance.

- Methods of response can be defined for different types of spillage or leakage and accidents.

- The instructions can provide models for drills and exercises, which the response organisation can use to evaluate its ability to respond to such incidents.

90. An example of such instructions are the joint-Nordic TOKEVA instructions.

III. IMMEDIATE RESPONSE

A. The Limitation of Consequences (immediate decision-making/crisis management)

91. The basis for the limitation of consequences is the alarm given within the plant as early as possible and the alert given to the emergency response authorities.

92. There should be a predefined management system from the level of daily preparedness management upwards, with a command centre responsible for the actions in the disaster area, composed of the emergency response operations director, relevant public authorities and the representative of the accident site or the industrial plant. It should be connected with the national emergency response authorities.

93. As indicated above, one recommended approach is a command structure incorporating the five functional areas of Command, Operations, Planning, Logistics and Finance be implemented. Additionally, the concept of Unified Command described above is recommended to greatly aid in conflict resolution and setting of response priorities. Through planning, training, exercises and drills, the roles and responsibilities, as well as the staffing contributions of the sending organisations, is well established. Individuals need to develop a sense of discipline in learning the job functions of their position as well as the functions of the remaining positions. Each person needs to know what information they need to do their job, where this information will come from and in what form (voice, written, e-mail, notes). They also need to know what is their output (reports, charts, purchase orders, action plans, monitoring information, GIS data), who needs this output and in what form will it be delivered. Once these requirements are learned, the staff can work together as an efficient and effective team. Cross training and relief training is necessary to provide depth and sustainability during an incident for shift changes and backup replacement staff. When carried out successfully, such training of individuals from very diverse backgrounds oftentimes builds a strong sense of comradeship within the community.

94. Many decisions effecting diverse entities will have to be made during the emergency response. These may include tactical, operational, environmental decisions. They may effect the industrial activities at the source of the event, neighbouring facilities, population centres, transportation facilities and traffic routes. Tactical decisions oftentimes require input from a variety of technical disciplines. For example, it might be more prudent from a health point of view to allow a chemical fire to burn. In this case the decision would generate activities distinct from a decision to extinguish the fire.

95. Again, emergency response operations require the ability to make rapid decisions that may extend beyond the normal authority boundaries of the individual making the decision. Authority requirements and limits need to be clearly identified for the appropriate incident command structure positions. Wherever possible, incident command positions should be staffed by organisations, agencies, authorities and company representatives who bring decision authority with them. For example, the position that controls evacuations should be staffed by representatives of local elected officials, such as police. Positions that commit financial resources, such as issuing purchase orders for response equipment, should be staffed by representatives of the responsible party or company with the discharge. Decisions effecting multiple jurisdictions should be made at the Unified Command level, such as plant closings or cross border impacts.

96. An interruption of the activities of the chemical storage facilities and the unloading and loading operations is not likely to cause a problem in the event of an accident. But bringing a large production plant to a standstill may require a wind-down of several hours and its restart will take an equally long time. In a clear case of accident, the activities are probably stopped without delay, but in unclear situations the representative of the establishment and the emergency response operations director may have divergent views of the gravity of the situation. The relevant operations at the establishment are most probably stopped at the emergency response operations director's command but the issue of compensation for the production shut-down may cause problems if the respective powers and authorities are not stipulated clearly enough in the national regulations.

97. The following are examples of decisions that need to be made quickly as the situation unfolds and therefore need to be assigned to the appropriate levels and positions within the Incident Command structure. Too many decisions focused on one individual, including too many direct reports, leads to indecision, incomplete decisions or wrong decisions. Delegation of control and decisions is critical for a successful emergency operation. Organisational span of control should not exceed seven individuals and preferably be no more then five. Even if someone has substantially more direct reports in their day-to-day position, the pressure of the emergency as well as the long hours can seriously effect ones thought process. Examples of decisions that need to be made quickly include:

- the order that the general alarm signal be given in the municipality;
- the launch of the external and internal response organisations into action;
- the order that the residents are evacuated from the endangered areas;
- the imposition, if necessary, of a curfew on the municipality; and
- the requisition of equipment and people needed for response operations.

B. Analysis During the Accident

98. A situational analysis of an accident involving hazardous substances, if it is not possible to prevent or to limit the consequences, should be possible with regard to its spreading, extent and consequences to people, property and the environment. If the response work is successful but still going on, further arrangements, for example, for the supply of response materials must be monitored continuously. In one case, there was a fire on a large storage tank that was put out with foam. While people went to get more foam from a place at some distance and neglected to ensure continuing foaming, the tank burst into flames again as soon as the foam vanished from the surface.

99. To facilitate this assessment, there is a variety of software that can be used to predict the extent of the damage. A working committee has been set up by the Finnish Ministry of the Interior to investigate these computer programmes and their reliability and suitability for the purposes of rescue administration. The tested programmes are of European and US origin. The decisions of the response management are based on their estimates of the extent of the damage to soil, air and waterways.

100. Among available sources for information on emergency response software is the Internet. Most emergency response organisations, such as the Red Cross and the US Environmental Protection Agency's Chemical Emergency Preparedness and Prevention Office (www.epa.gov/ceppo/), have links to lists of commercial and freeware. Additionally, the business continuity/disaster recovery field has developed numerous software programmes that can be used for risk assessment, planning and response management.

In North America go to the Disaster Recovery Institute, International site (www.dr.org) and in Europe go to the Business Continuity Institute site (www.bci.org). These will lead to many more sites, including commercial, government and not-for-profit.

101. In 1995, the US Coast Guard conducted a study of various chemical spill decision support systems (DSS) and DSS components in use around the world. The report, An Evaluation of Chemical Spill Decision Support Systems, was done for the US Coast Guard Headquarters, Office of Response (G-MOR), 2100 Second Street, SW, Washington, DC, USA 20593-0001. Thirty-six individual systems and system components were included in the survey. It should be noted that at least some of the systems have been modified substantially by their developers since the study was completed.

102. In the existing situation, it is critical to establish the spreading of the emission in the air. This can be established for most gaseous substances by rough estimates, by using a sector disc to estimate the spreading of the emission in the air on the basis of the wind velocity and the estimated amount of the emission (e.g. kg/second), if available.

103. If there is access to the above mentioned computer programmes, these should be run as quickly as possible.

104. The second task in order of urgency is to estimate the spreading of the emission in waterways, especially in rivers where water pollution can quickly contaminate drinking water and shut down water intake plants, or cause damage to them. The emergency response director must be aware of the environmental impact of the response methods (for example, in the Sandoz accident).

105. Emissions travel more slowly in the soil but soil is also the most difficult element to decontaminate. To estimate this and to get reliable information will take the longest time. In fact, the emergency response director may have transferred his command responsibilities to the environmental authorities before any forecasts are available.

106. The extent of damage to soil should be evaluated on the basis of the information the operator has obtained from his studies of the soil on the production plant site and in close vicinity thereto, taking also the results of the authorities' soil investigations into consideration.

C. Evacuation vs. Sheltering In Situ

107. In the event of accidents involving dangerous substances, it may be necessary to protect the operator's employees and the inhabitants of the district.

108. The sudden occurrence of the emission, its velocity and danger are the factors that enter into the decision whether there is enough time to evacuate the exposed personnel and the inhabitants, or whether they should be sheltered in the place. If there is a potential risk or if an accident has occurred, but there is no emission, it is possible to decide, on the basis of the situational analysis, whether to evacuate the people. The danger of emissions should be established in advance in the operator's risk assessment.

109. If the hazardous emission from an accident spreads quickly from the operator's site to the surrounding residential area, there is probably no time for an evacuation but the personnel and the inhabitants who live in the neighbourhood must find shelter in the place where they are. If they seek shelter in a building, it is important to shut off air intakes and all HVAC. Pre-planning is critical to identify the responsible staff to accomplish this task in an emergency.

110. With a view to sheltering in situ vs. evacuation, it is important to establish, in advance, with the rescue authorities and the operator:

- The velocity at which the production plant's dangerous substances spread in different types of accidents and under different climatic conditions;

- In light of the velocity of the spreading emission and the distance from the production plant established where it is possible/obligatory to:

- evacuate the population;

- find shelter in special facilities or civil defence shelters;

- find emergency shelter inside a building;

- Alarm to the population; and

- Instructions for actions in the event of hazardous emissions.

111. The industrial operations whose quantities of dangerous substances do not exceed the lower limits laid down in the Seveso II Directive and the municipalities with transport routes for hazardous substances will have to assess the need and possibilities of shelter on the basis of the estimates made by the emergency response authorities, unless the national regulations put this obligation on all operators and transport companies.

112. Where no pre-use risk assessments are available, the decision about sheltering in situ or evacuation will have to be made solely on the basis of the situational analysis.

113. In this regard, is also important to consider the time of the day with respect to the possibility of a sudden and rapidly spreading emission of hazardous substances. For example, will it make sense to give the general alarm signal in the early morning hours and wake up the people? How does the signal reach the people indoors?

D. New Technologies

114. Technology has developed rapidly in the 1990s. The emergency response authorities now have access to new tools for the control of the transport of hazardous substances and also the possibility to obtain much more quickly the information needed for emergency response operations.

115. New technology for emergency response has focused on risk assessment, impact analysis, incident command management methodologies, trajectory models, relational database management tools, data presentation for analysis, the use of templates, communication tools and networks, and overall information availability. Hardware for monitoring, GPS for tracking and GIS for positioning resources has led to much better control capabilities leading to better cost management. Actual improvements in the equipment used in cleanup has focused more on materials of construction rather then actual new devices or techniques. These new materials can increase life expectancy and reduce the cost of decontamination of response equipment.

116. It is recommended that those involved in emergency response investigate information available on the Internet. For example, response plans can be stored in html searchable format, which makes them instantly available to the entire team, and the specific information sections can be retrieved as needed

without having to thumb through a three-inch thick document. Reports can be transmitted via e-mail to remote field locations or headquarters regardless of the application used to create it using PDF format. Finally, report forms, which are all important to regulatory agencies, can be created, linked and managed using relational databases thus minimising redundant data entry.

117. A major concern of organisations in today's mobile workforce is loss of knowledge when employees transfer. New software is becoming available that captures this knowledge and makes it available to users through artificial intelligence or decision tree systems. A paper entitled Expert Systems for Emergency Response is attached as Appendix 2 to this Document.

118. At present, it is possible to install in vehicles, at reasonable expense, measuring instruments for radiation. In the event of an accident at a nuclear power plant, these vehicles can be driven around to map out the disaster area. The location of the vehicle is transmitted by a GPS sensor linked up to the built-in computer. The location data and the radiation measurements are sent in real time via a gsm/cell phone to government radiation control.

119. Information is often slow about accidents involving transport of hazardous substances outside an enterprise. Those responsible for rescue operations should have access to databanks.

120. The emergency centres that receive emergency and accident reports should have sufficient information about the hazardous substances in their region and, to the extent possible, also about the substances transported through municipalities. This information may be obtained in advance and fed into the computer which is used by the emergency centre and also by the emergency response operations director, or they may have access to national or international databanks, for example over the Internet.

121. For example, sea transport of hazardous substances can be monitored in real time and the emergency response authorities may be linked up to the control programme by a portable computer and a gsm/cell phone. In the event of an accident at sea, it is possible to establish, very quickly, by the ship's name whether or not it is carrying hazardous substances.

122. Chemicals hazardous to health and to the environment are increasing rapidly in number and variety, which is why the huge amount of information can no longer be recorded and stored by traditional methods in every municipality. If information about chemicals is centralised, the authorities who receive emergency and accident reports can have access to this data. In the event of an accident, information about the chemical properties can be sent to the scene of the accident, i.e. to the emergency response operations director's portable computer by a gsm/cell phone via the Internet, to a mobile phone communicator with a telefax, the Internet and the text message system, or to a telefax linked up to a mobile phone.

123. The population can also be warned about accidents by RDS technology. The Tetra standard in Europe allows the authorities to have radio communications without interference.

124. A new programme being made available in the United States is Operation Respond, a programme designed to improve information available to first responders at hazardous materials and passenger train incidents. Operation Respond is a not-for-profit institute co-funded by the US federal Highway Administration, the Research and Special Programs Administration and the Federal Railroad Administration. Participating rail and motor carriers provide funding support through programming, computer donations, software purchases, training assistance and administrative support. The software connects emergency responders with the databases of motor and rail carriers in the event of any hazardous

materials incident. Within seconds emergency responders can verify hazardous materials content from the carrier, obtain MSDS for the materials involved, obtain load/residue status information, obtain passenger and cargo train car schematics, and receive safety and emergency response recommendations. Information on this programme can be obtained from the Operation Respond web site at www.oreis.org.

IV. FOLLOW-UP TO CHEMICAL ACCIDENTS

A. When is the Emergency Over?

125. The end of emergency response operations should be viewed on a broad front. In most cases, it is easy to estimate the termination of rescue and salvage work relating to people and property. But in environmental accidents, active response operations may continue for days and weeks while hazardous substances travel in soil or groundwater. Emergency response operations may continue long after the fire departments, the medical services and the police have finished their work. The responsibility for continued emergency response operations may be transferred from one authority to another and it may also be reassumed, especially with regard to environmental accidents.

126. Generally speaking, with regard to emergency response services the emergency and risk situation may be considered to be over when the immediate danger of exposure to toxic substances or explosion has passed. This does not mean that the response work is done but that most of the emergency response units may return to preparedness for other accidents or disasters. In this case, the management of further work may be assigned to other experts.

127. If one uses a standard Response Management Systems approach to crisis management, there are generally two phases to the emergency: Emergency Phase and Remediation or Project Phase.

128. The Emergency Phase consists of four activities:

1. Mobilisation & deployment of personnel, equipment and material resources to begin the source control, containment, recovery and impact minimisation to affected populations and facilities.

2. Activate appropriate response plans and take tactical actions to deploy specified resources.

3. Begin data collection and detailed incident assessment.

4. Begin preparation of Incident Action Plan

129. The Project Phase begins (Emergency Phase ends) when response planning activities have produced, and Command has approved, the first Incident Action Plan. While emergency activities may still be underway, the incident has been stabilised and events and activities are able to be managed, albeit with some flexibility for the unseen. The Incident Action Plan provides the strategic goals and the tactical objectives around which activity is focused. It must be noted that if the incident re-escalates, then management reverts back to the Emergency Phase. The system should never replace one's ability to think. However, in the heat of the emergency, use of a plan template helps to focus ones attention onto priority decisions.

B. Learning by Experience (improving the ability to analyse and to apply the lessons)

130. Following an accident involving hazardous substances, it is necessary to assess the accident as soon as possible, and also to evaluate how successfully it was handled. Such evaluation should address, e.g., preparedness of personnel, the equipment used, the information of the hazardous substances involved in the accident, completion of the information, contacts with experts, and functioning of the emergency response plans.

131. The accident should be reviewed and following conclusions drawn concerning:

- How should the accident have been handled and was the response method correct and the best?
- What equipment was used and where would equipment have been available?
- Were the response people experienced in view of the actions needed to prevent the damage in question?
- Did the authorities and the company work smoothly together?

132. It is critical to document the results of these reviews, including the findings, recommendations and conclusions, what went well and what needs improvement. Usually these "Hot Washes" capture more useful information then can be assimilated by a single individual. It is therefore recommended to organise the after-action discussions along functional lines, i.e., Command, Operations, Planning, Logistics, and Finance. Each of these groups is then assigned the task of producing concise reports for distribution to all teams. Action items should be highlighted, prioritised and assigned to a person responsible for its completion according to an agreed upon schedule. This will ensure the capture of the valuable lessons learned.

C. Investigations

133. If a commission of inquiry is set up for the accident, the emergency response authority should be represented on the committee.

134. The existing emergency plan (internal/external) should be reviewed in light of the analysis (including cause and effects of the accident) in the final report, and necessary corrections should be made in the plans. The corrections made in the external plan should be approved by the next higher authority above the municipal level and the corrections in the internal plan should be approved jointly by the authority who issued the licence to the establishment, if any, the local emergency response authority and the higher emergency response authority.

V. TRANSBOUNDARY CONSIDERATIONS/ACCIDENTS WITH EFFECTS ACROSS ADMINISTRATIVE BOUNDARIES

A. Harmonising Assessments

135. The municipalities' risk assessments should include an assessment of those accidents which may reach across the municipal boundaries. Possible risk assessments of joint-operation districts should address the accidents and respective preparedness. National emergency response authorities should list, jointly with companies, those risks which may have effects across the national borders.

- On the basis of the assessment, contact should be made with the neighbouring country's emergency response authorities. The estimated risks that may have a cross-border impact should be brought up in the discussions.

- After the risks have been established, the next step should be to have discussions at municipal level, attended by the above mentioned parties and the emergency response authorities of the respective municipalities.

- In the municipal discussions and based on the neighbouring country's risk assessment, the municipality's resources should be assessed with regard to the threats, with an estimate of the assistance required from within the country/the neighbouring country.

- A reporting procedure should be agreed upon for the event of sudden accidents.

B. Notification and Information

136. After the harmonisation of the risk assessments, a procedure should be agreed for reporting accidents to the neighbouring country's authorities. The authorities who are involved should very quickly inform the media and the people in their own countries and in the neighbouring countries, if requested by that country's authorities. In this regard:

- An accident that threatens to escalate across the border into the neighbouring country should be reported, as agreed in advance, to the emergency centre in the respective area which will launch emergency response operations in accordance with the emergency plan which has been revised after the risk assessment.

- The emergency centre that receives emergency and accident reports should immediately alert the local emergency response authorities and notify the national emergency response authorities.

- Upon notification of the accident, the national emergency response authorities should decide about the allocation of additional resources, if any, to the municipality in question and about the sending of assistance to the neighbouring country, or about a request for assistance from the neighbouring country. After consulting with local emergency response authorities and with the respective authorities in the neighbouring country, the national emergency response authorities may call off the alarm.

- Information about accidents is promulgated by the media world-wide much earlier than by the authorities.

137. The emergency response authorities of the municipality where the accident has occurred should focus in their communications on the consequences of the accident in their own country only and on the response actions taken, in order not to cause confusion in international newscasts and in order not to give the population in the neighbouring country a wrong impression of the impacts of the accident.

C. Moving People / Equipment Without Hindrance

138. In the event of accidents that have impacts across the borders, it may be necessary to move rescue people and equipment across the borders. The exposed population may have to be evacuated temporarily to the neighbouring country.

- The moving of equipment and emergency response personnel should be based on jointly-made risk assessments approved by and between the neighbouring states.

- Based on an advance evaluation, the emergency response equipment should be suited for response to the accident in the neighbouring country and, if possible, compatible with the equipment in the neighbouring country.

- The procedure for assistance requests should be smooth and the emergency centre should be able to alert and send, on the basis of the emergency plan, the required emergency response, medical and expert resources to the neighbouring country.

- A report should be given to the national emergency response authorities, without delay, concurrently or immediately after the alarm. The national emergency response authorities can give formal permission to send additional help, if needed, to the neighbouring country, or they can issue an order, on the basis of the situational analysis, to the dispatched emergency response units to turn back.

- The national emergency response authorities, jointly with the border authorities and the competent public authorities, should agree about the procedure to permit crossing of the national borders without delay. Border control authorities from both countries need to be involved in the planning activities so as to be prepared to expedite the movement of people and equipment.

D. Worker Protection

139. Arrangements should be made in advance, on the basis of the risk assessment, for the protection of emergency response personnel. Hazardous substances released in the event of an accident should be identified and the required protective apparel and equipment estimated thereupon.

140. Emergency Response Plans for areas with border issues need to incorporate in the safety plan information concerning worker safety while in the neighbouring country. Location and contacts for hospitals, EMTs, and ambulances, identification of known physical hazards, contacts for police and fire fighters are examples of this needed information. It must be understood that language differences may cause problems and translations for key phrases might be included in the documentation of the plans.

E. Liability Issues

141. In fire and traffic accidents, in accidents involving hazardous substances and in other daily "simple" accidents, the responsibility for the costs of the accident generally falls upon the party who caused the accident. The collection of costs from the party who caused the accident is regulated by national laws. The party who suffered damage may, however, receive compensation through a variety of insurance systems.

142. A problem arises in the event of an accident that affects neighbouring states. If the neighbouring countries have agreed in advance about the alerting of rescue personnel on the basis of harmonised risk assessments, liability issues might also be agreed upon.

143. Countries vary significantly in their liability laws and legal procedures for third party claims. Cross border emergency response cost reimbursement claims against another country will therefore be difficult to pursue at best, and perhaps more costly then the expected reimbursement. It suggested that municipalities, and contractors make arrangements with the company responsible for the discharge for cost reimbursement prior to initiating action across borders, rather then pursue claims against another country.

144. It should be noted that countries indemnification and immunity laws vary significantly as well. Persons and companies operating outside of their home country need to familiarise themselves with these differences and be aware of the financial risks prior to undertaking activity.

APPENDIX 1

ANALYSIS OF RISK ASSESSMENT METHODS USED IN DIFFERENT EU-COUNTRIES AND IN NORWAY
(Part of a report prepared in the framework of European Union co-operation in the field of civil protection)

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INTRODUCTION

1. Accident prevention and prevention of disasters have been recognised by the EU member states as one of the main co-operation areas in the field of civil protection and emergency services. Risk assessment is evidently an essential and important part of this work. For example, those making emergency plans, both on- and off-site plans, need risk assessments to evaluate the possibilities of fire brigades, emergency services and first responders to prepare for and to respond to identified accidents. The Authorities of civil protection and emergency services as well as operators need risk assessment in its different forms for several purposes in order to guarantee safety in the society.

2. As a result of the discussions carried out in different fora, the Civil Protection Unit of the European Commission has set up an expert group on the environmental impacts of natural and technological disasters. One of the working areas of this expert group is risk analysis in the field of civil protection and emergency services, taking also environmental aspects into account. Finland wanted to contribute to this work by providing the expert group with secretary work and carrying out some preliminary surveys on the use of risk assessment methods in Europe.

3. The objective of this exercise was to note how member states have used risk assessment methods in the field of civil protection and emergency services and how the environmental aspects have been taken into account. A Panel on Risk Assessment was called together for this purpose.

4. The first meeting of the Panel on Risk Assessment was held in Brussels on 8 December 1997. Representatives from Germany, Finland, Sweden and the Netherlands participated this meeting. In this first meeting the Panel discussed the need to develop the risk assessment methods and the need to exchange data and experiences on the use of various risk assessment methods between the EU-countries. As a result of the meeting, the Panel decided to carry out a basic questionnaire in order to find out how and to what extent member states use various risk assessment procedures in the field of Rescue Services and/or Civil Protection.

5. The questionnaire was sent to the PNNC of each EU-country and to the members of the expert group mentioned previously. Answers were received from following countries: Austria, Belgium,

Denmark, Finland, France, Germany, Greece, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Sweden and the United Kingdom.

6. The second meeting of the Panel on Risk Assessment took place 26 May 1998. At this meeting the representatives of the member states decided to go on with the project by collecting more data and by making some closer studies on the use of risk assessment procedures in five members states. The states chosen for this purpose were Denmark, Finland, Germany, the Netherlands and Sweden. The work was later accepted as a pilot project by the DGXI /Civil Protection Unit and it was carried out in the Finnish Environment Institute.

BACKGROUND ON RISK ASSESSMENT STUDIES

7. The improvements of the methods of risk assessment has become a world-wide interest during the recent years. One milestone of this development was the OECD Workshop on Risk Assessment and Risk Communication in the Context of Chemical Accident Prevention, Preparedness and Response, held in Paris in 1995 (Document OCDE/GD(97)31). This workshop, as many other events in the field of risk assessment, focused on the fixed installations and the risk assessment procedures applied to them. Also a wider perspective of the use of risk assessment procedures was, however, taken into account in the recommendations and conclusions.

8. An important publication in the field of practical use of risk assessment procedures from both industrial and the Rescue Services point of view is the UNEP IE/PAC (1992) Technical report on Hazard Identification and Evaluation in a Local Community. The aim of this report is to be a handbook and to show with practical examples, how risk objects can be identified, evaluated and ranked by a basic "rough-analysis" method. The handbook emphasises co-operation at local level which should lead to co-ordinated, effective and economically practical risk management, influencing both the existing hazards and the shape society will take in the future.

9. The UNEP handbook is based on the 1989 Swedish Rescue Services Board Handbook on Risk Analysis. The Nordic Countries have on the whole done plenty of work on developing the risk assessment methods providing a planning base for the fire and Rescue Services. Handbooks of this kind have been published also in Norway and in Finland.

10. In the Netherlands and the United Kingdom practical risk assessment methods to help the planning of Rescue Services have been in use for several decades. In both countries these methods are based on a real estimation of risk in the communities.

GENERAL REMARKS ON THE STUDY

11. The scope of the study was to collect information from different EU-countries in order to get an extensive view of the use of risk assessment procedures in the field of Civil Protection and Rescue Services in the EU-area.

12. The basic questionnaire was sent out in spring 1998. The questionnaire was formulated in rather a general form, which resulted in answers scattering widely in their focus. Some trends of conclusions can, however, be drawn from the answers.

13. The need to use risk assessment procedures in the field of Rescue Services in general was clearly recognised by the member states, but the way in which assessments were carried out - if at all - varied considerably. Most of the answers clearly stressed the responsibility of industry in risk assessment work in

accordance with the Seveso I Directive and other legal obligations. A clear conclusion is that risk assessment methods used in the field of Rescue Services (Fire Action) are mostly qualitative in nature ; they are e.g. check lists and general assessment methods. In the field of industry, quantitative methods are used more frequently.

14. Short analysis of the answers to each question is given below.

SUMMARY OF THE RESULTS OF THE BASIC QUESTIONNAIRE

Question 1: Do you think that the risk assessment is needed in the field of Civil Protection and Rescue Services?

15. In general, risk assessment - and risk/hazard identification as a vital part of it - is regarded as an important part of the system of emergency preparedness and control (emergency management). The importance of risk assessment is also widely recognised in better acknowledgement of risks and risk communication to the public.

16. Some answers pointed out the usefulness of risk assessments in dimensioning the rescue forces and optimal allocation of resources in the field of Rescue Services (Denmark, Finland, the Netherlands, Norway, Portugal). Sweden and the UK stressed the importance of co-operation of different actors in the society in the field of risk management.

17. The goal of establishing internationally accepted procedures for risk assessment work was pointed out by Greece.

Question 2: Do you use some kinds of “Risk Assessment Procedures”, the term understood in a broad sense, in the field of Rescue Services (Fire Action) and/or Civil Protection in your country?

18. Here the answers were twofold. On one hand, the use of qualitative risk assessments in setting reaction times for Fire Brigades was mentioned. This was based mostly on the estimation of risks in certain areas/buildings and around hazardous installations (Germany, the Netherlands). On the other hand, the responsibility for the use of risk assessment in industry and transport of dangerous goods was pointed out (Denmark, Germany, Portugal). Luxembourg mentioned the use of automatic monitoring and alarm systems for floods and nuclear emergencies.

19. Finland, Norway and Sweden described the specific systems of risk assessment procedures used at municipal level in the Rescue Services in these countries.

Question 3: Is the risk assessment used voluntarily or is it an obligation set by legislation or on some other grounds?

20. In all the countries risk assessment is a legislative obligation for some specific fields of industry – at least for Seveso installations. In some of the countries the local authorities – usually the municipalities - are obliged to study the risks in their own area. These countries are Finland, Germany, Greece, the Netherlands and Norway.

21. In Greece all risk assessments are carried out by public authorities but industry is responsible for providing the authorities with all the information needed to fulfil this task.

Question 4: What kinds of <risk assessment> methods do you use? Do you use qualitative or quantitative methods or both?

22. The risk assessment methods were divided in the questionnaire into qualitative and quantitative ones in a following way:

Qualitative risk assessment methods
- General methods
- Identification of risks
- General assessment of the consequences of identified risks
- Other methods (to be explained)

Quantitative risk assessment methods
- HAZOP
- Probabilistic risk assessment
- Fault tree
- Event tree
- Human error analysis
- Environmental risk assessments
- Other methods (to be explained)

23. The quantitative risk assessment methods are explained in a few words below:

HAZOP - is used to identify risk factors and potential operational problems in the process as well as work out the course of an accident or a break in the production.

Probabilistic Risk Assessment- is a systematic analysis method in which a combination of technical faults and operational mishandling probably leading to an accident are recognised.

Fault Tree Analysis- is used to identify combinations of mistakes and mechanical faults that may lead to certain kinds of damage.

Event Tree Analysis- is used to identify and evaluate initial events which may lead to damage by illustrating the connections that exist between various stages in an accident.

Human Error Analysis- is used for one particular aspect of operation or maintenance, the operator's response to various situations are documented in a logical order and mistakes with potentially serious consequences are noted.

24. Different countries had understood this question in a slightly different way. In the individual explanations it became clear that in most countries industry may choose to use whichever quantitative methods they wish. This explains why some of the answers list almost all quantitative methods and others mention none of them – all meaning the same thing.

25. Listing the qualitative methods seems to describe more closely what kinds of risk assessment methods are used in the field of Rescue Services and Fire Action in general. Here at least identification of risks and consequence assessment are used in almost every country.

26. Answers of each country are summarised in Table 1.

Table 1. Summary of the risk assessment methods used in different countries.

Methods	AU	BE	DK	FI	FR	GE	GR	IR	NL	NO	PT	SW	UK
Qualitative													
General methods	X	X		X	X	X		X		X	X	X	X
Identification of risks	X	X	X	X	X	X		X	X	X	X	X	X
Consequence assessm.	X	X	X	X	X	X	X	X	X	X	X	X	X
Other methods		X				X					X	X	
Quantitative													
HAZOP		X		X					X	X	X	X	
Probabilistic r.a.	X			X					X	X		X	
Fault tree		X		X					X	X	X	X	
Event tree	X	X		X					X	X	X	X	
Human error analysis	X	X		X						X		X	
Environmental r.a.	X	X		X					X	X	X	X	
Other methods		X					X						

Explanation: AU= Austria, BE= Belgium, DK= Denmark, FI= Finland, FR= France, GE= Germany, GR= Greece, IR= Ireland, NL= the Netherlands, NO= Norway, PT= Portugal, SW= Sweden, UK= the United Kingdom.

27. Some countries explained their answers separately:

Denmark: "In the daily work of the Emergency Management Agency, no quantitative risk assessment methods are used as a foundation for a decision."

Germany: "All the qualitative methods are used for civil protection purposes including semi-quantitative ones (e.g. MET). Additionally "lessons learnt" play an important role to increase preparedness. Quantitative methods are used by industry, consultants and authorities as part of licensing and supervising activities."

Sweden: "All methods mentioned above are used in Sweden in different ways by different actors. Qualitative methods: We are starting to develop new methods and tools for accident prevention. One important tool is GIS (Geographical Information System). Quantitative methods: The above mentioned methods and tools are developing to a more quantitative state of art. One example is the used data from emergency responses and causes for accidents, especially fires."

France: "The two qualitative and quantitative methods are used. The qualitative methods are used especially to improve means of prevention and procedures. These methods are still to be developed and improved. The quantitative information makes us possible to take into account the human means and the materials in use and to improve the understanding for future accidents. These methods are: general for the methodology and specific according to the type of risk."

Question 5: For what purposes are these risk assessment are carried out?

28. Different purposes for risk assessments were given in the answers, which can be listed as follows:

1) identification of risks
2) classification of risks (e.g. chemical installations)
3) hazard type/seriousness evaluation
4) accident prevention
5) consequence analysis, consequence restriction
6) developing the emergency preparedness in general
7) forming a basis for emergency planning
8) risk communication
9) evaluation of risk scenarios
10) dimensioning of response forces

29. Answers to this question varied considerably, and the individual so the separate answers of each country is given below.

Luxembourg: Luxembourg is confronted with 3 types of risk assessments:
* nuclear industries
* floods
* industries of the SEVESO type.

Denmark: The following aspects can be illuminated carrying out a thorough risk assessment:
* The different kinds of accidents that can occur
* The most severe accidents
* The critical events and actions that lead to the accident
* The probability of such events/accidents
* The consequences of such accidents
* Establishment of the proper precaution measures.

Germany: The assessment defines the risk and its geographical distribution in the area, it helps to classify various technical sites especially in the nuclear industry and in the fields of industry of the SEVESO type and the obligation of their operators to support the civil service authorities. It is therefore the base for emergency planning in Civil Protection and Rescue Services.

Greece: To evaluate the probability of any disaster and take the required steps to avoid or restrict the consequences.

Ireland: Development of emergency preparedness.

The Netherlands: Quantitative risk analyses are made for land use planning. For the Rescue Services, general assessment of the emergencies of risks and event tree analysis is used.

Sweden: For accident prevention, for emergency response purposes, for occupational safety and for environmental protection. The purpose is to assess the needs for measures.

The United Kingdom: To eliminate the risk and to aid the response should a disaster occur.

France: Risk assessments are carried out in order to get an understanding of and to be able to analyse hazard phenomena as well as to be able to improve the plans for prevention and the

procedures in a case of an accident. They also help us to evaluate different kinds of risk scenarios which have been created.

Portugal: For acknowledgement of risks and analysis of consequences.

Norway: "To make adequate arrangements and dimensioning of response and other protective measures."

Question 6: Who carries out the risk assessments? Authorities, trade, industry or consultants? Who gets the results of the risk assessments?

30. As a general rule, industry is responsible for carrying out risk assessments required by legislation. They can choose to use consultants or make the risk assessments themselves. In many countries, the authorities can get the results of these risk assessments and take advantage of them in public emergency management (Germany, the Netherlands, Portugal). In Greece and Ireland only public authorities are responsible for carrying out risk assessments in their areas but industry has to provide them with all the information needed. In most of the countries Rescue Services are responsible for carrying out at least some kinds of risk assessments or risk evaluations needed for their own purposes. The local authorities may also use consultants in their risk assessment procedures.

Question 7: Can you identify and list for example five to ten most common and important types of accidents, major accidents or even disasters, which should be considered in these risk assessments?

31. In the questionnaire the receivers were asked to list five to ten of the most common and important types of risks or even hazards which should be considered in the risk assessments.

32. There was a large variation in the identification of different hazards between the countries. The variation is partly explained by the geographic position of each country. On the other hand, differences in hazard identification can be thought to reflect also the cultural prioritisation and acceptance of certain risks in each country.

33. For instance, the UK and the Netherlands gave nuclear accidents clear priority while Ireland, Denmark and Greece did not even mention risks of this kind. Greece clearly prioritised natural disasters before man-made accidents. Luxembourg, UK and Greece did not mention ordinary fires at all in their lists.

34. The geographical position of a country is a single factor which has the most effect on the types of hazards to be recognised, especially when natural disasters are concerned. In Southern Europe earthquakes, volcanoes and forest fires dominate the hazard palette. In Central Europe, in mountainous areas avalanches and in the areas of large river basins or in low land areas by the coast floods are hazards of great significance. Moving further up to Northern Europe the effects of long and cold winters are of greatest concern, though extreme weather is an even larger hazard in those areas which are not usually prepared for e.g. snow storms. Landslides and land-flows are significant hazards in areas of high relief and/or certain type of clayey soils.

35. As the French Ministry of the Interior pointed out in its answer, in the classification or prioritisation of hazards also such parameters as the rapidity of the event, its economic, social and environmental influence, number of potential victims and "political importance" among others should be taken into account. Actually, as they formulated, the classification of risks is of no real value; if these parameters lying behind the classification process are not stated clearly enough.

36. Summary of accident types identified in different countries is given in Table 2.

Table 2. Accident types identified in different countries. Note that many answers only reflect a personal opinion of the representative of the country.

Country	AU	BE	DK	FI	FR	GE	GR	IR	LU	NL	NO	PT	UK
Hazards													
FIRE	X	X	X	X		X		X		X	X	X	
EXPLOSION	X	X	X	X		X				X		X	
TRANSP.HAZMAT	X	X		X		X					X		
ROAD		X	X	X	X	X	X	X		X	X		X
RAILWAY		X	X	X		X		X		X	X		X
AIRPLANE		X				X		X		X			X
SEA							X	X		X			
GAS. EMISSION	X	X		X		X				X	X	X	X
FLUID EMISSION		X	X	X		X			X	X	X	X	X
INDUSTRIAL	X	X		X				X	X		X	X	X
WATER POLL.	X									X			
NUCLEAR EM.										X			X
FLOODS	X				X	X	X		X	X	X		X
AVALANCHES	X				X				X				
CYCLONES					X								
LAND-SLIDE	X				X						X		
EARTHQUAKE	X				X		X			X			
VOLCANOES					X		X						
FOREST FIRES				X		X	X						
EXTREME WEATH.						X	X	X		X			
TUNNELS											X		

Question 8: Do you take into account also the effects to the environment in these risk assessments?

37. When member states were asked whether they take into account the effects to the environment in their risk assessments, the answers were strongly scattered.

38. Denmark and Sweden made it clear that environmental risk assessments are crucial part of their policy. The representative of Denmark explained this question more thoroughly. He pointed out how important it is to understand that human and environmental protection are two connected aspects and, therefore, a risk assessment leaving the environmental aspect can not be accepted as a complete and thorough one. He gave an example of risk assessments done on a chemical plant in order to avoid spill of toxic liquids forming a risk to ground water and to the sea. Here a thorough risk assessment would illuminate the actions to be taken in order to achieve an acceptable protection level against accidents of this kind.

39. In Finland environmental risk assessments have during the recent 10 years been done together with the environmental authorities and industry. The main aim is better application of the Water Act to minimise water pollution caused by industrial activities.

40. The German representative considered that risk assessment in the field of civil protection deals primarily with people. The impact on the environment is, however, also considered, but mainly for cases of technical accidents (e.g. hazmat-release, pipeline leakage), far less for the effects of natural disasters.

41. In the Netherlands environmental risk assessment methods for the contamination of surface water are available. Their use is obligatory for installations that discharge effluents in surface waters.

42. In Belgium environmental impact assessment is done as part of the industrial hazard analysis and it takes mainly the aspects of water pollution into account.

43. Luxembourg and Greece answered that risk assessments do not take into account the effects on the environment. Greece pointed out that the Ministry of the Environment carries out assessments of this kind. Likewise the United Kingdom answered "yes" and explained that the Environmental Agency is involved in the planning process if necessary. Ireland mentioned particularly chemical and pharmaceutical industry hazards as an example for the application of environmental risk assessments.

44. France explained that the effects on the environment are taken into account when producing the plans of prevention and for the documents on urban development. These documents determine the basic conditions for land use. They can, in some cases, prohibit for instance the construction of a hazardous installation.

Question 9: Do you use these risk assessments for evaluating your Rescue Services' and/or Civil Protection services' possibilities to respond to emergencies?

45. On the basis of this question, the countries can be classified in two groups: those who use risk assessments as a tool in dimensioning or evaluating the response capability of their Rescue Services and those who do not use them.

46. In Germany the organisation, structure and resources of the Rescue Services are created at municipal, provincial or state level according to the hazards existing in the area. In Greece risk assessments are used to evaluate the possibility for urgent response measures to be taken by the Rescue Services. In Finland, Norway and Sweden risk assessments are regularly used to evaluate the capability of municipal rescue forces to respond to the emergencies in their area.

47. On the other hand, in Denmark and in the United Kingdom risk assessments are not used in this field. Portugal is in a preparative phase in the use of risk assessments from this point of view.

Question 10: Do you use municipal risk assessments for preventive measures in enterprises or for preparedness and in what respect?

48. Preventive measures required from industry are most often based on risk assessment work done by enterprises themselves (Finland, the Netherlands, Norway, Sweden). In Germany and Greece risk assessments done at a municipal level are used more generally as a basis for emergency preparedness and response i.e. also for the preparedness of enterprises. In Greece risk assessments are only done at a prefectural level by the public authorities.

APPENDIX 2

"EXPERT SYSTEMS FOR EMERGENCY RESPONSE"

By: Albert J. Slap, Vice President, Business Development, GeoSphere Emergency Response Systems, Inc.[1]

EMERGENCY RESPONSE AND MANUAL SYSTEMS

1. Emergency response. It is a capability that most large businesses or governmental enterprises must not only posses, but own! Organisations need to "own" emergency response and crisis management for some very important reasons. Emergency management exists to prevent or minimise injury to workers and the public; protect property, plant and equipment; reduce risks; and, to provide documentation and accountability. Historically, crisis management has relied upon paper-based, manual systems. Manual approaches, although effective to a degree, are very time-consuming and labour-intensive. On a total cost basis, manual systems are quite expensive to maintain precisely because they *are* so labour-intensive. Furthermore, the quality of the data in manual systems degrades quickly. Each time a chemical process unit is modified or a pilot plant added, paper plans must be modified. Because changes occur rapidly in the manufacturing environment, however, most paper-based, emergency response plans may be out-of-date even before the 3-ring binders hit the shelves. Manual systems are simply too slow and cumbersome for effective use in actual emergencies.

COMPUTER-BASED SYSTEMS

2. The advent of the computer and the PC, in particular, has improved some of the deficiencies in manual systems for crisis management. Electronic databases, such as chemical property tables or material safety data sheets (MSDSs), make it easier to get critical information on chemical risks, personal protective equipment (PPE), etc. in a timely manner. But, gaps still remain. Most database management programs are not designed to be "real-time systems." Generally, they are not very user-friendly and so do not permit many among the emergency response staff to use them. This has also been a problem with some computer-based, crisis management systems in the past, which required highly trained operators or contractors to utilise them in real-time.

3. Other software tools have been specifically developed for or adapted to emergency response. These include: trajectory models (air dispersion or oil spills), geographic information systems (GIS), and automated notification equipment, such as autodialers or group pagers. Again, problems still exist. The attempted use of separate tools simultaneously or sequentially can lead to confusion and error. No software system covers *every* aspect of emergency response and crisis management. Numerous aspects of the emergency response effort may need to be covered by an electronic system.

4. They include:

- Crisis Plan Preparation
- Training and Simulation
- Detection and Alarm Management

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- Assessment – GIS, Video, Digital Imagery
- Decision Support –
  - Trajectory Modelling
  - Database Management
  - Expert Advisory Systems
  - Forms Management/ICS
  - Automated Notification
  - Response Resource Tracking and Computer-Aided Dispatch
  - Cost Recovery
- Post-Incident Reporting and Remediation
- Web-enablement
- Mobile Systems – Remote data entry

WHO NEEDS COMPUTER-BASED CRISIS MANAGEMENT?

5. A wide variety of private and governmental entities require advanced emergency response capabilities. Organisations that can use and benefit from such technological advancements in crisis management include:

- Chemical plants
- Manufacturing facilities
- Pharmaceuticals production
- Energy generation and distribution facilities and pipelines
- Maritime Industry
- Military
- Law enforcement/Anti-Terrorism
- Emergency Management - 911
- Schools and Hospitals

6. Obviously, the chemical processing industry, with its necessary use of hazardous materials, often at elevated pressure and heat, has a need for computer-based crisis management. This is also true for many pharmaceutical and non-chemical manufacturing plants. The transportation and maritime industries have similar needs, because of their storage and trans-shipment of hazardous materials and the potential severity of mishaps. Energy and pipeline companies can have accidents that cause serious environmental consequences, with releases on a very large scale. Recently, law enforcement on the federal, state and local level has had to deal with terrorist acts, school shootings, militia and hate group violence, bomb threats, etc. County emergency management (911 centres) and hospitals are some of the first groups involved in mass casualty situations, whether they are caused by man-made or natural disasters. The benefits to these organisations from technological solutions will differ, depending on the organisation's mission, the risks posed by the operation, and the size and budget of the organisation.

WHAT IS THE RIGHT SYSTEM?

7. What is the right system or tool set for any particular organisation? What is the process that an organisation should go through to assess its current level of emergency preparedness and to decide what technological improvements it should it adopt?

8. First, an organisation should look at its present state of preparedness. Are plans and procedures really up-to-date? Does out-of-date information in paper plans and procedures present a risk of harm to

persons, property or the environment, if an accident occurs? The new Risk Management Plan Rule (RMP) implemented by the United States Environmental Protection Agency (EPA) in June, 1999, requires organisations that store, handle or use certain amounts of hazardous chemicals to report their five-year accident histories (among other things). This information can be illuminating on the issue of preparedness. What is the RMP's worst case scenario for a particular facility? What is the level of public trust and scrutiny? Will there come a time when a company needs more public confidence and acceptance (e.g., to obtain expansion permits, etc.)?

9. Secondly, an organisation should assess the true cost to the organisation of maintaining its paper-based systems? Those costs usually include time spent in updating plans, copying plans, distributing updated plans, etc. With the significant cutbacks in personnel in most large companies, it may no longer be secretaries or clerks who are doing this work, but safety managers or EH&S professionals, themselves. A clear advantage of computer-based, emergency management systems is that plans, procedures, checklists, and other emergency resources are updated electronically and made instantly available to appropriate personnel on the LANs, WANs, intranets or even the Internet.

10. Third, what is the level of training in the organisation? Can an organisation's personnel actually do what emergency plans and procedures require them to do in a timely and effective manner? Or will panic, general confusion and mistakes abound? What are the likely consequences of mistakes? Is the training program sufficiently site-specific or is it too vague and generic? What is the annual cost of the organisation's training program? PC-based systems are now available to provide highly customised, site-specific training simulation at a reasonable cost. Such simulation technology enables the enterprise to evaluate the readiness of its emergency response staff in realistic field and desktop exercises, without requiring as much time at expensive, off-site training centres.

11. A fourth part of this evaluation should be an examination of whether the organisation has a process to maintain and preserve corporate expertise for crisis response. This is an important and often overlooked aspect of emergency preparedness.

EXPERT SYSTEMS IN EMERGENCY RESPONSE

12. What do we mean by maintaining and preserving corporate expertise, anyway? For any organisation to succeed there is a need to move forward on what we refer to as the "knowledge continuum." This continuum starts with unmanaged data. For the company that sells goats, for example, basic unmanaged data may simply mean knowing that the company stocks a product called "goats." That is helpful, but not very. Knowledge is the next higher level on the continuum. It implies a higher order of information than raw data. Using the example of a company that sells goats again, "knowledge" might tell the company sales force how many goats are in inventory on any given day ("we have 10 goats in stock, today"). The data on goats is now organised in a way that is more useful to the primary mission of the organisation, i.e., selling goats. The next and highest level on the knowledge continuum is "expertise."

13. Expertise within an organisation is usually built up over a long period of time and *may* reside with just a few "old timers." Each organisation has spent a great deal of time and money training those experts. Another way of saying this is that the company has an economic stake in the expertise that resides in its employees' brains. In the example above, a company expert may let the sales force know that they should watch out for the goat named Elmer, because he is prone to butt anyone who comes too close to him. This is obviously an important piece of expert advice that should be quickly passed along within the organisation, lest injury result to the unsuspecting salesman who approaches the goat, Elmer. But, if only one old-timer knows about Elmer (because he was the only existing employee around the last time Elmer

was in the inventory) and, he was just let go with a severance package and is fishing in Montana, then someone is going to get butted!

14. How do organisations capture and preserve not just emergency response expertise, but all sorts of business rules? Typically, this is done in an informal way, with on-the-job training. It is rare to find an organisation that has implemented a regular and continuing process to convert its "lessons learned" into written policies and procedures. And, if the organisation does have such a program, it is likely that expertise is being put into a manual system of 3-ring binders and not an electronic, decision-support system. "Lessons learned" is the valuable act of "downloading" corporate expertise. If the lessons learned only reside in reports or paper-based systems, it is unlikely that they will be incorporated into training or will be available in real-time emergencies. In most cases, unfortunately, expertise is not captured and preserved by these organisations. Senior staff are permitted to retire, downsizing and outsourcing take place, without much formal effort to "download" their expertise prior to leaving the company. What is the overall cost to the organisation of this "brain drain?" It is a cost that is very hard to measure, but it is probably very high.

15. This is where expert systems or decision-support systems can help. Expert systems are a type of artificial intelligence. The basic idea of an expert system is simple. Expertise is transferred from experts to a database, typically in the computer. The expert's knowledge and thought processes (sets of questions and guidance) are stored in the computer and multiple users can access the expertise when and as needed. Expert systems can be set up to ask the user simple, English-language questions, and provide multiple-choice paths of response. So, as the user reads the questions and selects the most appropriate answers, the expert system identifies the appropriate path in one or more electronic decision-tree matrices and posts answers to the questions, recommendations, or guidance. Expert systems are also called "rules-based" systems, because the expert has given the computer a set of rules by which to operate (called a Knowledge Base). These are often stated as IF, THEN rules. For example, the expert system is programmed to operate in the following manner, IF the user defines the situation as a CHEMICAL EMERGENCY, THEN the expert system will post the most up-to-date protocols that are appropriate for a chemical emergency.

16. The expert system can also be used for decision-support in many different areas. These include: hazardous chemical spills and releases, fires, explosions, emergency medical services, oil spills, natural disasters, workplace violence, anti-terrorism, and more. Decision-Support systems also have many daily uses such as site security management, hazardous work permits, and maintenance troubleshooting, etc.

17. Typically, an organisation will consider using expert systems in the following situations:

- When the solution to the problem has a high payoff;
- When the cost of maintaining expertise within the organisation is high;
- When expertise is needed in many different locations;
- When large amounts of data must be sifted through quickly in the decision-making process;
- When expertise is needed in hostile or hazardous environments;
- When an error in the decision-making process could lead to disastrous results;
- When there is a shortage of experts available to the organisation;
- When the expert system is needed for training as well as decision-making; and,
- When expertise is needed to augment the knowledge of junior personnel.

18. A common complaint of corporate executives is: "we don't know what we know." Employees are always trying to re-invent the wheel – failing to leverage the lessons learned, best practices and expertise that exist throughout the enterprise. The expert system for crisis management can effectively collect, document, catalogue and distribute corporate knowledge and expertise in a way that makes it

accessible and useful in real-time. When corporate knowledge is used in this effective manner, productivity goes way up.

THE EXPERT SYSTEM AS "MISSION CONTROL"

19. Today's PC-based, expert systems are quite sophisticated and can also operate as an intelligent manager over many existing parts of a plant's distributed control system (DCS). For example, expert systems can act as alarm managers. They can collect and interpret detector or sensor information, monitor weather data from meteorological stations, and feed data from such systems into other software modules, such as GIS, trajectory models, or emergency notification equipment. The expert system can be programmed to automatically take certain actions, once it receives signals from DCS equipment. E.g., a gas detector, when activated, can send a signal to the expert system, which will then activate the autopage system, select an alphanumeric message to broadcast to specified response personnel. The expert system can also activate the decision-support system, which will post immediate action recommendations to the computer, and show a graphic representation of a toxic gas cloud over a GIS map or CAD drawing, all within a matter of seconds.

KNOWLEDGE MANAGEMENT

20. The expert system can also be seen as part of a broader concept called "knowledge management." Use of expert system technology has the ability to leverage information and expertise to improve safety, and foster organisational innovation, responsiveness, productivity and competency. Not only can an expert system be used to tie together the disparate software programs in crisis management described above, but also it can function as a rallying point to collect and preserve corporate expertise. The safety group or similar entity that is in charge of emergencies at a facility can, over a span of months and years, regularly use the expert system for training and real-time response. The safety manager or others can create a type of "electronic suggestion box" (e.g., a Lotus Notes database) to regularly collect the knowledge, expertise, and lessons learned from team members. Then, at regular intervals, the best of the suggestions of the team will be uploaded to the expert system's Knowledge Base for that particular area of decision support. This collaborative system will work, even if team members are distributed in geographically disparate locations. In the future, the preservation of organisational memory and expertise and the leveraging of knowledge in real-time will be critical factors to an organisation's ultimate success. In today's fast-paced business environment, organisations must find new ways to utilise the knowledge that they already possess.

WHAT TO DO IN THE FACE OF UNCERTAINTY?

21. Given the situation facing an organisation, what should it do? Stay with "business as usual?" Purchase separate crisis management tools from separate vendors? Create an in-house system? Seek out and evaluate integrated crisis management systems, including expert systems? Implement one or more of the above? It is hard to know what the right path is for any particular organisation. In the face of global competition, budgets are tight. The resulting corporate consolidation and downsizing just exacerbates the problem of preserving corporate expertise.

22. First, an organisation should consider a needs assessment. The business case for electronic crisis management systems should start with a baseline assessment of financial and non-financial factors. This may involve looking at the real costs of business as usual: the costs of manual systems, the costs of employees constantly "re-creating the wheel", and the history of past accidents and mishaps. Sometimes, vendors can provide assistance in cost-justification analysis or establishing a value proposition. This may also include an evaluation of hidden costs like lawsuits, government enforcement (fines and penalties), and workers' compensation claims. Going to conferences and trade shows are important ways of finding out

about new technologies and learning from colleagues what is working or not working for them. Furthermore, understanding the culture of any particular organisation may play an important role in the success of implementing electronic decision support systems for crisis management. Leadership and support from senior management will play a vital role in helping new technologies and systems gain acceptance.

A FEW WORDS ABOUT THE FUTURE

23. It will be here sooner than you think. Are you one of those unfortunate souls old enough to remember wondering whether you would really need a computer in your job? Well, while *we* were wondering, a revolution started and it is ongoing, today. It is the information technology revolution. It is coming at us at fibre optic speed. Web-based software systems, wireless personal digital assistants (PDAs) with internet and voice capability, virtual reality simulation for the PC, and new and more sophisticated types of artificial intelligence (e.g., data mining) are just around the corner. How many of you think that you will still be relying exclusively on paper crisis management plans two years from now? How about five years from now? Probably, just a small percentage. Now is the time to get serious about rebuilding your crisis management and emergency response systems in the age of information technology.

ANNEX 2

OECD WORKSHOP ON NEW DEVELOPMENTS IN CHEMICAL EMERGENCY PREPAREDNESS AND RESPONSE
3 - 6 NOVEMBER 1998
LAPPEENRANTA, FINLAND

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