United Nations

International Decade for Natural Disaster Reduction

IDNDR Early Warning Programme

Report on Early Warning for Technological Hazards

Convener of International Working Group, and first author:

Dr. Peter Krejsa

Austrian research Centre Seibersdorf

Austria

IDNDR Secretariat, Geneva October 1997

EARLY WARNING FOR TECHNOLOGICAL HAZARDS

CONTENTS

FOREWORD

In 1989, the member states of the United Nations declared the period from 1990 to the year 2000 to be the International Decade for Natural Disaster Reduction (IDNDR). Its objective is to "reduce the loss of life, property damage, and social and economic disruption caused by natural disasters, through concerted international action, especially in developing countries".

The fundamental importance of early warning for realizing this objective of disaster reduction was recognized in 1991. The IDNDR's Scientific and Technical Committee declared the subject a program target, by which the success of the Decade would be judged by the year 2000. By drawing on global scientific knowledge and practical experience, the Decade's advisory committee encouraged all countries to ensure the ready access to global, regional, national and local warning systems as part of their national development plans. The IDNDR Secretariat has since coordinated an international multi-disciplinary framework to promote this issue. In doing so, it has been able to draw on the comprehensive views and abilities of the United Nations system, needs and concerns of individual countries, and related global expert knowledge.

The critical nature of early-warning for the protection of vital resources and for addressing national development objectives was highlighted by a technical committee session devoted to the subject at the United Nations' World Conference on Natural Disaster Reduction held in Yokohama, Japan in May 1994. Several of the expert presentations cited the importance of public policy commitment for successful early warning. The primary outcome of the Conference, The Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation further emphasized the importance of applied scientific knowledge and the public's awareness of hazard risks as essential components for more effective early warning practices.

The IDNDR Secretariat was requested by the United Nations General Assembly in 1995 to coordinate a review of the existing early warning programs and to suggest means by which global practices could become better coordinated and made more effective. Initial information was conveyed by the Secretary General's Report on Early Warning to the Fiftieth Session of the United Nations General Assembly in October 1995. (UN Document A/50/256, 9 October 1995). At that time, a further examination of new scientific and experimental concepts for accurate and timely short-term forecasting was requested of the IDNDR for the purpose of making recommendations on the applicability and development of more effective early warning in the context of international cooperation.

For the current work, six international expert working groups were convened to study different aspects of the early warning process: geological hazards, hydrometeorological hazards including drought, fire and other environmental hazards, technological hazards, the use and transfer of related modern technologies, and national and local capabilities pertinent to the effective use of early warning. Guiding Principles for Effective Early Warning were also compiled by the conveners.

This following report of the Working Group on Early Warning Capabilities for Geological Hazards summarizes global experience and reviews the current state of knowledge and practice on the subject. Recommendations are also made for improvements and areas that require additional international attention. The conclusions reflect the views of scientific and technical experts as well as those of the United Nations departments and agencies concerned. An effort was made to ensure that views of government authorities, non-governmental organizations and other elements of civil society were also represented, particularly as they relate to factors which determine the efficacy of early warnings.

This report is one of a series issued by the IDNDR Secretariat in October 1997 to review the current state of early warning systems. By the end of the Decade, these views will contribute to final recommendations for improved, and better coordinated, practices in fulfillment of the initial IDNDR program target for the subject. They will first be considered by an International Conference on early

warning systems for the reduction of natural disasters which has been held in Potsdam, Germany in September, 1998. This technical and scientific conference focusing on the application of successful warning practices was sponsored by the Government of Germany with the collaboration of United Nations' agencies and international scientific organizations. As a major topical event of the IDNDR closing process and the consolidation of global views, the conference has identified those accomplishments and local experiences which can best improve organizational relationships and practical effectiveness for early warning into the 21st century.

The following titles compose the series of information reports of the IDNDR Early Warning Programme:

Early Warning Capabilities for Geological Hazards
Early Warning for Hydrometeorological Hazards, Including Drought
Early Warning for Fire and Other Environmental Hazards
Early Warning for Technological Hazards
Earth Observation, Hazard Analysis and Communications Tech. for Early Warning
National and Local Capabilities for Early Warning
Guiding Principles for Effective Early Warning

The Secretary General's Report on Early-warning Capacities of the United Nations System with Regard to Natural Disasters presented to the Fiftieth Session of the United Nations General Assembly, October 1995. (UN doc. A/50/526).

The Secretary General's Report on Improved Effectiveness of Early-warning Systems With Regard to Natural and Similar Disasters presented to the Fifty-second Session of the United Nations General Assembly , October 1997. (UN doc. A/52/561).

These reports may be accessed on the IDNDR web site: http://www.idndr.org or on the EWC'98 web site at http://www.gfz-potsdam.de/ewc98/ They also may be obtained from the IDNDR Secretariat, Palais des Nations, CH-1211 Geneva 10 Switzerland. or by Fax: +41-22-917-9098, or E-mail: idndr@dha.unicc.org

I. INTRODUCTION

Technological hazards are an increasing source of risk to people and their environment. This is an effect of the globalization of production, an increase of industrialization and a certain level of risk of accidents connected with production, processes, transportation and waste management. These risks are associated with the release of substances in accident condition or with the production of such substances under certain conditions as fire. Substances which could affect human health or the environment by contamination and their effects on animals and plants.

Severe accidents have happened which afflicted thousands of people. These have found expression in the public demand to provide technical and organizational tools for the prevention, mitigation and relief of disasters. Special international attention has focussed attention on incidents of Bhopal, Mexico City, Basel, Seveso, the "Exxon Valdez" and Chernobyl. Expert groups, institutions, organizations, authorities and institutes work on the problems of prevention and relief on local, regional, national and even global basis.

Each of these accidents have been of a different kind, due to different reasons and substances involved and therefore also the consequences were of different nature. The Chernobyl accident led directly to the International Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. The release of chemicals into the Rhine River was a starting point for bi- and multinational agreements concerning early warning systems for accidental releases of hazardous materials into rivers.

In regions with high density of industrialization, where a risk of this kind of accident is evident, guidelines, regulations and legislation have been developed and adopted. The Convention on the Transboundary Effects of Industrial Accidents of the United Nations Economic Commission for Europe provides an example of agreed measures for the prevention, preparedness and response to industrial accidents capable of causing transboundary effects. They also provide exemplary experience about the feasibility of fostering international cooperation in this field.

There are guidelines, regulations, and specific directives for substances whose handling, processing, transportation or production is related to risks for human beings and the environment, do exist. There are practical procedures on the presentation of measurements, information, modelling and risk assessment. Data which is necessary for technical emergency response exists, as do several different material description systems, logistics concepts etc. The extent of this existing information, operational procedures, and communication systems constitute the basis of numerous existing infrastructures. In such cases of an abundance of capabilities distributed over many implementing areas of responsibility, it may be necessary to reconsider, or at least rationalize, these systems where transboundary risks may be anticipated.

Obviously technical, legislative and institutional methods already exist to deal with technological hazards. With few exceptions, technological hazards are not ordinarily of global dimensions. Transboundary effects, may however, become a consequence of an accident. Considering the amount and distribution of facilities using hazardous materials throughout the world, the risks posed by them to societies and the environment it has to be considered as an increasing global problem. This situation is likely to be expanded further as the consequences of human activities and technological processes on phenomena such as global warming, and ozone depletion becomes better understood. International terrorism is also being cited more as a potential source of other forms of chemical or biological contamination of crucial elements of a society.

There is a certain probability that the expanding genetic technology (gentechnology) will pose more problems of this kind in future. Substances in which self-reproduction is possible will need special global considerations. Another form of related threat is evident today by the transfer of biologically-active substances or species to places where they can destroy the natural established

equilibrium. Special precautions will be necessary to avoid contaminations with unpredictable effects to the environment.

Taking into consideration other possible effects of accidental releases of hazardous materials, including their progressive accumulation in plants, animals, fish or entire ecosystems, they can now more easily be distributed to very different regions of the world. Hence, the emergence of increasing risks of technological hazards has to be seen on a global dimension. A global threat of technological hazards can also be seen in the fact that facilities which may not comply with the safety standards enforced in industrialized countries can readily be transferred to poor, or non-industrialized, countries. It should be possible to overcome such problems when using special environmentally designed facilities or "cleaner technologies", (e.g. Best Available Technology, or B.A.T.).

With this future outlook, it is therefore necessary to globalize the efforts for the reduction of technological hazards. This can be done by considering some principles and technical guidelines for the implementation of adequate preparedness and prevention measures. The strong emphasis which is being given to this subject now by so many countries, shows that there is the understanding on the national basis of the importance of these issues. There are many bilateral and multilateral agreements concerning the involvement of more than one country in such a problem, however, a growing density of industrial activities demands far more risk reduction than is presently evident. Major accidents can have long-lasting consequences, with many of them that extend beyond frontiers of an individual country. The ecological and economic cost of an accident is borne not only by the establishment affected but also by the States concerned. It must become an objective to keep the risk level as low as possible, taking into consideration the probable character of increasingly complex, and potentially more severe, technological incidents. It therefore becomes necessary to take measures that can ensure a high level of protection.

It is anticipated that there may be a recognized value in considering a global agreement to address international problems arising from technological hazards. The aim would be to harmonize, standardize information and methods, where a response action from more than one country is necessary and where international aid can be expected. This should also be understood as a contribution to overall global risk reduction in a consistent and efficient manner. This should in fact go beyond harmonization, but actively address collective measures which are necessary to realize a more effective system for preventing major accidents and limiting their consequences.

It is necessary to consider what could become the activating mechanism for such an early warning system. Again, global warning will at the moment be limited to few technological activities. A globally-oriented warning system could be understood in the sense of encouraging the widespread and common usage of recognized information systems, and data provision. systems. In this context technological hazards can be seen in connection with major threats of the following types:

- accidents and releases where radionuclides or radiation are involved,
- a release of chemical substances in accidental conditions to the environment, or
- activities which could lead to a release of biological substances, or organisms.

Based on the Yokohama Message and as a result of the World Conference on Natural Disaster Reduction in 1994 it is considered that technological hazards need to be addressed in all aspects of disaster management capabilities, *viz*. disaster prevention, mitigation, preparedness and relief. In terms of early warning, however, the main emphasis should be directed toward disaster prevention, mitigation and preparedness to achieve the goals and the objectives of the International Decade for Natural Disaster Reduction. Disaster response should only be considered as applying measures in cases where all prevention measures have failed. Regrettably, it yields only temporary results at a very high cost. In the case of technological disasters this would be of very limited use, as it must be considered that regions affected by technological accidents can be of reduced utility by societies or for human habitation for a very long time, due to the long-lasting effects of many technological contaminants.

Based on this understanding early warning for technological hazards must be seen on different levels and with different concepts and tools. Early warning concerns an immediate risk as it is in the case of accidental release of toxic substances which could be transported via air and water. It must address risks which will become manifest in form of damages into the future, such as for example the use of materials, chemicals, but also an accumulation of substances released by the production, or the post-consumer phase of products. Therefore, the long term problems associated with slowly emerging effects, or other consequential manifestations, of technological hazards have to be specifically discussed. In some circumstances, the longer term influence could be even more important to the well-being of a society or to the future generations of its present inhabitants, than the more evident, short term consequences addressed on a more immediate, and temporary time scale. Therefore, the significant risk of technological hazards, in fact, demands concentration on the prevention of their occurrence, an opportunity that can be enhanced when one appreciates that they are, by definition, a function of human creation.

Basic Issues and Definitions

Dangerous substance shall mean a substance, mixture or preparation fulfilling specified criteria and present as a raw material, product, by-product, residue or intermediate, including those substances which it is reasonable to suppose may be generated in the event of accident.

Major accident shall mean an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment and leading to serious danger to human health and/or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.

Hazard shall mean the intrinsic property of a dangerous substance or physical situation, with a potential for creating damage to human health and/or the environment.

Risk shall mean the likelihood of a specific effect occurring within a specified period or in specified circumstances. The risk as a quantity being the product of the probability of an accident leading to a release of substance and the potential of damage due to a defined specific situation.

Nature of an Early Warning System for Technological Hazards

Most of the releases of substances into the environment are due to accidental situations. As early warning detection systems can act through measurement equipment which can indicate dangerous situations of processes (e.g. temperature, pressure). These measurements can act as indicators for on-site alert systems. By contrast, the situation becomes significantly more complex as one considers external effects of technological hazards where warning systems must additional relate to,

- measurements, data acquisition, sampling,
- data transfer for processing (risk estimation, decisions, alarm, assistance),
- information dissemination to public and authorities, decisions about information levels, local, regional, national, international exposure, and
- reaction for widely ranging relief measures.

Both on-site and off-site contexts require that early warning possibilities be utilized mainly to optimize reactions and to make sure that the necessary personnel and equipment to reduce the effects is available. In case of technological hazards, early warnings need to be based on the anticipation of risks and a certain predictability of accidents which can be established by using known techniques for risk and consequence analysis. Such assessments will be used primarily to avoid, or at least to

minimize, the risk of situations with a technological hazard. This can be done by appropriate safety measures embodied in established disaster prevention programs.

To establish reasonable risk hierarchies, special tools such as Risk Analysis, Life Cycle Analysis (LCA) and comparable methods should be used, and where necessary, developed. Data bases for these tools should be provided, and where necessary, such data should be evaluated.

Indicative List of Technological Hazards

The following list indicates the type of actions which can constitute technological hazards:

- release of chemicals to the atmosphere by explosion, fire
- release of chemicals into water (groundwater, rivers etc.) by tank rupture, pipeline rupture, chemicals dissolved in water (fire),
- oil spills in marine environment
- satellite crash (radionuclides)
- radioactive sources in metallurgical processes
- other sources of releases of radionuclides to the environment
- contamination by waste management activities
- soil contamination
- accidents with groundwater contamination (road, rail)
- groundwater contamination by waste dumps (slowly moving contamination)
- aircraft accidents
- releases and contaminations as a consequence of military actions (e.g. depleted uranium), or destruction of facilities
- releases as consequence of the industrial use of biological material (e.g. viruses, bacteria, fungi)

Prediction of Effects

The prediction of technological hazard effects is closely related to prior risk analysis. By developing a scenario, the probability of events and effects can be predicted. Thus enabling the competent authority to establish an alert system and to take care for the provision of equipment, facilities, hospitals, transportation system for specific scenarios. It will be very important to have a reasonable balance between technical and organizational provisions on site and relief measures which have to be borne by the public. Decision tools will be given by risk analysis and related methods, such as fault tree analysis and event tree analysis.

II. LIST OF TASKS

Context of Early Warning for Technological Hazards

This working group has been tasked with technological hazards, including accidental nuclear, chemical or industrial releases, structural or infrastructural system failures. The following discussion covers the range of possible forms of chemical or nuclear release and/or technological or infrastructural failure that endangers people, property or the environment. Because of the complexity and potentially catastrophic or long-term effects, hazards associated with technological development pose particular challenges to the operators of facilities, public policy authorities, and indeed, members

of the public which live and work in the midst of hazardous materials that have become an integral part of most societies.

Chemical or industrial releases include incidents or the accidental release of substances to the environment. The pathways are water and air. Water contamination can affect rivers, lakes, groundwater or marine environments, such as by spills. The main emphasis will be directed towards accidental releases where amounts of toxic substances can come into the environment. The transmission of dangerous substances through pipelines also has a potential to produce major accidents. States may equally adopt measures to limit similar risks identified with waste landfills.

Nuclear releases cover incidents with materials which are not only necessarily those involved with nuclear facilities. There is a much wider exposure in the context of all those other facilities using radionuclides or nuclear radiation in industry, research and medicine. Within this scope are radiation sources and liquid or gaseous releases. Another important issue are releases of natural long-lived isotopes from mill tailings, settling tanks and purification ponds.

Incidents with an involvement of structural or infrastructural system failures may consist of technical, operational or organizational failures. As people and pieces of equipment are, themselves, part of the infrastructure a physical breakdown (of either), or serious lapses of communication can contribute to the creation of technological hazards. In this respect, safety practices must be regarded as an integral part of contemporary, industrial risk analysis. High tech facilities need a special technical environment for functioning. If such facilities pose the potential for human or environmental risks, than a procedural lapse or a weakened part of the physical infrastructure can create an unacceptable risk.

Challenges of Technological Hazards

The main emphasis of early warning practices pertaining to future global activities for technological hazards need to be directed toward the following issues:

i) Providing emergency warnings of an imminent technological threat to the environment.

ii) Systematic analysis of information, its timely and effective processing, its use and dissemination based on a broad, and multidisciplinary range of specialist involvement.

iii) Identification or disclosure of technological hazards with adverse effects on the environment, existing in the midst of communities which are unaware of the threat. Communities may also grow to envelop potentially hazardous facilities, which may have previously been appropriately isolated.

iv) Determination of early warning procedures to alert, identify, evaluate and inform the public and/or official authorities concerned with public, or societal, risk about sources of potential risks.

v) The anticipation of appropriate means of prevention or response of multiple-hazard risks, which could follow from causal relationships between natural and technological disasters.

vi) Instruments to ensure the timely and adequate notification to authorities of countries which might be affected by a technological hazard.

vii) Identification of agreed contents for a prospective convention to minimize the environmental, health and economic consequences of technological hazards.

viii) Developing standards for the presentation and use of data, and components of a common information structure, such as an event scale to facilitate the notification, and common understanding of accidents. This would also enable a common understanding of the events among the technical and local communities concerned.

ix) Encouraging translation of technical facts for the benefit of improved media and public comprehension.

x) Instituting prompt and consistent information of the public of various aspects pertaining to hazardous materials and public safety.

xi) Prepare awareness activities and preparedness plans for emergencies at the local level, including effective community collaboration for responding to industrial accidents.

xii) Expanded use of existing conventions, rules and local or regional systems for the development of global nomenclature and advisory standards in dealing with technological hazards.

xiii) Improved use of the experience and, to the extent that it may be feasible, existing collaborative systems of international organizations, based on the reliability and technical abilities of their partners.

xiv) Develop a general scheme of relating national and international agencies in order to achieve an effective process of communication and the coordination of emergency assistance, when necessary.

These tasks can be separated into two dimensions. First there are the organizational problems which may be addressed in the context of substantive elements of an agreed convention, or generally accepted agreement, that would establish its basic purpose and objectives, and the use of existing organizational structures. Secondly, there is the technical basis for common understanding, involving such matters as the international basis and utilization of data, methods of communication, equipment and technical processes involved, etc.

III. ACTIVITIES OF AN EARLY WARNING SYSTEM WHICH COULD BE BASED ON INTERNATIONAL AGREEMENTS

The crucial tasks which have been related to organizational and technical questions can be addressed by establishing specific structures, or harmonizing existing conventions, national regulations and bilateral agreements. Guidelines can provide the basis for promoting and assisting in data collection and the improvement or consolidation of processing systems, communication systems and decision-making procedures. These responsibilities could, by common understanding and commitment, be overseen by an international organization. It bears emphasis, however, that different responsibilities outlined in the following areas of action would have to be borne by operators of facilities, public authorities, national governments, and the local communities themselves, through an accepted partnership of the beneficial attributes of reduced risk for the community as a whole from technological hazards in its midst.

Disaster Prevention and Mitigation

The analysis of major accidents indicates that the majority of them are the result of managerial and/or organizational shortcomings. It is therefore necessary to establish basic and accepted principles for management systems, which can encourage the prevention and control of major-accident hazards, and limiting their consequences, should they unavoidably occur.

Differences in the arrangements for the inspection of establishments by the competent authorities may give rise to various levels of protection. Nonetheless, it is desirable to lay down essential

requirements with which the systems for inspection established by the subscribing parties should comply.

Principles

Operators of establishments where dangerous substances are present in significant quantities should be expected to provide the competent authority with information to demonstrate that all necessary activity has been done to prevent major accidents, to prepare contingency plans, and appropriate response measures. This could take the form of a safety report containing details of the establishment, the dangerous substances present, the installation or storage facilities, and the possible major types of accidents that could be anticipated. In addition, a detailed description could be provided, in the establishment's *own* interests, of the management systems in place to prevent or to reduce the risk of major accidents, and to enable the necessary steps to be taken to limit any consequences.

Where establishments are sited in such a way as to increase the possibility of major accidents, to aggravate their consequences, or to raise concern about consequential effects, there should be a provision for the exchange of appropriate information and cooperation on public information. Considering the consequences of the accidents in Bhopal, India and Mexico City, which demonstrated the hazard which arises when dangerous sites and dwellings are situated closely together, there is a clear necessity for land-use planning when new installations are authorized or when urban growth and development takes place around existing installations.

In order to promote greater access to information about the environment, the public should have access to safety reports produced by operators. Those people and communities which are especially likely to be affected by a major accident should be given sufficient advance information to inform them of the correct action to be taken in that event.

In the case of establishments where dangerous substances are present in significant quantities, to protect against emergencies, it is necessary to establish external and internal emergency plans. It is equally important to create systems that can ensure those plans are tested through drills and exercises, and revised as necessary, so that they are fit to be implemented in the event of a major threat or accident.

Accidents or threatened hazardous events which States regard as being of particular technical interest for preventing future accidents should be notified to the organization. There should be criteria for the notification of an accident in such a manner to make it useful for other public authorities so that they may also reconsider their own potential risks with similar systems, facilities or situations. Such criteria should be based on any fire or explosion or accidental discharge of a dangerous substance involving injury to people, or damage to property or the environment.

This would include any accidents directly involving a dangerous substance and giving rise to any of the following events: death, people injured within the establishment and hospitalized, people outside the establishment hospitalized, dwellings outside the establishment damaged and unusable as a result of the accident, the evacuation or confinement of people, or the interruption of drinking water, electricity, gas or telephone services.

The event could also be of sufficient importance for wider reporting if it causes permanent or long-term damage to terrestrial habitats concerning: a habitat of environmental or conservation importance protected by legislation, an area of more widespread habitat, including agricultural land, significant or long-term damage to freshwater or marine habitats, a significant damage to an aquifer or underground water. Problems associated with the consequential effect on docks, coastline, water, and estuaries would also have to be considered.

For assessing damage, appropriate guidelines should be available for application in relation to specific substances, or to the lethal concentration of the species representative of the environment affected and for the criterion dangerous for the environment.

There is a need for common efforts among states working towards greater mutual understanding and harmonization of national principles and practices regarding safety reports. In this respect it is desirable to pool the experience gained through different approaches to the control of major accidents, and to make provisions applicable to all establishments where dangerous substances are present in sufficiently large quantities to represent a major hazard.

The staff of an establishment must be engaged as active participants in the design of the internal emergency plans and the public also must be involved on external emergency plans. In order to provide greater protection for residential areas, areas of substantial public use and areas of particular natural interest, it is necessary for land-use and other relevant policies to be applied. In the long term, it is in the interests of the States and public authorities concerned to take measures that ensure a suitable distance between such areas and establishments presenting hazards. They also need to take account of additional technical measures so that the risk to people is not increased.

To ensure that adequate capabilities and operational measures are available if a major accident occurs, the operator must immediately inform the competent authorities and communicate the information necessary for them to assess the impact of that accident. In order to provide for an adequate exchange of information and to prevent future accidents of a similar nature, public authorities should forward information to an agreed body regarding major accidents occurring in their territory. This would then provide a possibility to analyze the hazards involved, and to engage a system for the distribution of information concerning, in particular, major accidents and the lessons to be learned from them. Ideally this information exchange should also cover near misses which States regard as being of particular technical interest for preventing major accidents and limiting their consequences.

An example of this type of internationally recognized process would be the acknowledged procedures in force for analyzing and then publicizing international airplane accidents, their causes, and recommended remedial actions that can be quite specific. The International Civil Aviation Organization (ICAO), an intergovernmental organization, provides what could be a useful example of a mechanism to address technological hazards through collective interests organized to reduce global risks.

Operator responsibilities

Explicit risk analysis requirements should apply to any establishment where dangerous substances are present in quantities equal to or in excess of the specified quantities. The presence of dangerous substances should mean the actual, or anticipated, presence of such substances in the establishment, or the presence of those which may be generated during loss of control of an industrial chemical process. It should include all the equipment structures, pipework, machinery, tools, private railway sidings, docks, unloading quays serving the installation, jetties, warehouses or similar structures, floating or otherwise, necessary for the operation of the installation.

Subscribing parties should ensure that the operator is obliged to take all measures necessary to prevent major accidents and to limit their consequences for people and the environment. The operator should be required to prove to the competent authority by inspections and controls that he has taken all measures necessary as may be specified in their operational licenses. In addition, to maintain the current reliability, it is important that the operator send the competent authority a notification for new establishments, prior to the start of construction, or prior to operation, for existing establishments. Such information should contain all the information about location, operators, materials involved and change in operation and material amounts.

Operators should be expected to complete a document detailing their major accident prevention policy and to ensure that it is properly implemented. These policies should be designed to guarantee a high level of protection for people and the environment by appropriate means, structures and management systems. The document should take account of the established principles and be made available to the competent authorities.

Public authority responsibilities for reporting and public information

States should ensure that the competent authority, using the information received from the operators, identifies establishments or groups of establishments where the likelihood and the possibility or consequences of a major accident may be increased because of the location and the proximity of such establishments, and their inventories of dangerous substances. In this respect there is a need to ensure that in the case of the establishments thus identified:

i) Suitable information needs to be exchanged in an appropriate manner to enable establishments to take account of the nature and extent of the overall hazards of a major accident in their major accident prevention.

ii) Provision has to be made for cooperation in informing the public and in supplying information to the competent authority for the preparation of external emergency plans. States should require the operator to produce a safety report for the purposes of:

- Demonstrating that a major accident prevention policy and a safety management system for implementing it have been put into effect.

- Demonstrating that major accident hazards have been identified and that the necessary measures have been taken to prevent such accidents and to limit their consequences for man and the environment into the design, construction, operation and maintenance of any installation, storage facility, equipment and infrastructure connected with its operation which are linked to major accident hazards inside the establishment.

- Demonstrating that internal emergency plans have been drawn up and supplying information to enable the external plan to be drawn up in order to take the necessary measures in the event of a major accident.

- Providing sufficient information to the competent authorities to enable decisions to be made in terms of the siting of new activities or developments around existing establishments.

These safety reports should contain at least the data and information specified and it should also contain an updated inventory of the dangerous substances present in the establishment safety reports, or parts of reports, or any other equivalent reports produced in response to other legislation, may be combined to form a single safety report for the purposes of this Article, where such a format obviates the unnecessary duplication of information and the repetition of work by the operator or competent authority, on condition that all the requirements of this Article are complied with.

Before the operator begins construction or operation, the competent authority should within a reasonable period of receipt of the report, either communicate the conclusions of its examination of the safety report to the operator, if necessary after requesting further information, or prohibit the initiation or continued use of the establishment concerned. The safety report should be periodically reviewed and where necessary updated: (e.g. at least every five years), at any other time at the initiative of the operator or the request of the competent authority, where justified by new facts or to take account of new technical knowledge about safety matters. This may, for example, arise from analysis of accidents or, even “near misses”, or derived from further knowledge concerning the assessment of hazards.

Ultimately the objective should be to establish harmonized criteria, and commonly accepted norms of the society concerned, for the decision by the competent authority that an establishment is in a state incapable of creating a major accident. States should ensure that the competent authority communicates a list of such establishments concerned to the organization

Contingency emergency plans

States should ensure that, the operator draws up an internal contingency emergency plan for the measures to be taken inside the establishment, for new establishments, prior to commencing operation, and for existing establishments the operator supplies to the competent authorities, to enable the latter to draw up external emergency plans, the necessary information.

The emergency plans must be established with the following objectives:

i) Containing and controlling incidents so as to minimize the effects, and to limit damage to man, the environment and property.

ii) Implementing measures necessary to protect people and the environment from the effects of major accidents.

iii) Communicating necessary information to the public and to the emergency services or authorities concerned in the area.

iv) Providing for the restoration and clean-up of the environment following a major accident.

It is a fundamental issue that public authorities should ensure that the inventory of dangerous substances is made available to the public as part of their contingency plan. This must necessarily also include a presentation of the environment of the establishment. It should contain a description of the site and its environment including the geographical location, meteorological, geological, hydrographic conditions. If necessary, it should also consider the additional relevance of its history; identification of installations and other activities of the establishment which could present a major accident hazard, and a description of areas where a major accident could occur. A description would be necessary of the main activities and products of the various parts of the establishment which are important from a safety standpoint. This could include sources of major accident risks and conditions under which such a major accident could happen, together with a description of proposed preventive measures; description of processes.

Particular details should include details of the operating methods, an inventory of dangerous substances, including their description in the following terms:
- the identification of dangerous substances;
- chemical name, CAS number, name according to IUPAC nomenclature;
- the maximum quantity of dangerous substances present or likely to be present;
- physical, chemical, toxicological characteristics and indication of the hazards, both immediate and delayed for people and the environment;
- physical and chemical behavior under normal conditions of use or under foreseeable accidental conditions; and
- identification and accidental risks analysis and prevention methods.

A detailed description of the possible major accident scenarios and their probability or the conditions under which they may occur should be presented, including a summary of the events which may play a role in triggering each of these scenarios, whether the causes could be internal or external to the installation; assessment of the extent and severity of the consequences of identified major accidents; and a description of technical parameters and equipment used for the safety of installations.

Details should be provided of available measures for protection and intervention to limit the consequences of an accident, including an organization of alert and intervention, description of mobilizable resources, both internally or externally available.

For the purpose of implementing the operator's major accident prevention policy and safety management system, account would have to be taken of the following elements. The major accident prevention policy should be established in writing and it must include the operator's overall aims and

principles of action with respect to the control of major accident hazards. The safety management system should include the part of the general management system which includes the organizational structure, responsibilities, practices, procedures, processes and resources for determining and implementing any major accident prevention policy within the establishment or any of its facilities. Overall, the fundamental aspect of the safety management system must address the organization and personnel, the roles and responsibilities of personnel involved in the management of major hazards at all levels in the organization.

Internal emergency plans should be drawn up in consultation with personnel employed inside the establishment and that the public is consulted on external emergency plans. States should ensure that internal and external emergency plans are reviewed, tested, and where necessary revised and updated by the operators and designated authorities at suitable intervals of no longer than three years. The review should take into account changes occurring in the establishments concerned or within the emergency services concerned, new technical knowledge, and knowledge concerning the response to major accidents.

States should then ensure that emergency plans are put into effect without delay by the operator and, if necessary by the competent authority designated for this purpose. This would apply when a major accident occurs, or when an uncontrolled event happens, which by its nature, could reasonably be expected to lead to a major accident.

Public authority responsibilities for land-use and public policy procedures

Designated public officials should ensure that the objectives of preventing major accidents and limiting the consequences of such accidents are taken into account in their land-use policies and other relevant policies. They should pursue these objectives through controls on the siting of new establishments, modifications to existing ones, or for new developments including transportation links. In addition, locations frequented by the public and residential areas in the vicinity of existing establishments should be carefully accessed for risks associated with the siting of facilities or developments which could present the risk or consequences of a major accident.

States should ensure that their land-use and other relevant policies, and the procedures for implementing those policies, take account of the need to maintain appropriate distances between establishments and residential areas, areas of public use and areas of particular natural sensitivity or interest. In the case of existing establishments, this implies the need for additional technical measures so as not to increase the risks to people.

Communication and information exchange

Public authorities should ensure that all designated officials and planning authorities responsible for decisions in this area set up appropriate consultation procedures to facilitate implementation of the policies established. The procedures should be designed to ensure that technical advice on the risks arising from the establishment is available, either on a case-by-case or on a generic basis, when decisions are taken. States should ensure that the public is able to give its opinion in the process of planning for new establishments, when making modifications to existing establishments, and when there are new public developments considered for construction around existing establishments.

National authority or local administrations should ensure that information on safety measures and on the requisite behavior on the event of an accident is supplied, without their having to request it, to persons liable to be affected by a major accident originating in an establishment. The information should be reviewed after a defined time period and, where necessary, revised. It should also be made permanently available to the public. The maximum period between the repeated provision of the information to the public should, in no case, be longer than five years.

With respect to the possibility of a major accident originating within an establishment of one country, with transboundary effects, there is a special obligation for States to provide sufficient

information to other potentially affected States. When a subscribing party has decided that an establishment close to the territory of another State is incapable of creating a major accident hazard beyond its boundary, and it would not therefore be required to produce an external emergency plan, it should inform the neighboring state accordingly.

For the purpose of prevention and mitigation of major accidents, States should provide information as soon as practicable of major accidents which have occurred within their territory. The following details are crucial for any accident reporting:

- the location and State concerned;
- name and address of the authority responsible for the report;
- date, time and place of major accident, including the full name of the operator and the address of the establishment involved;
- a brief description of the circumstances of the accident, including the dangerous substances involved;
- the immediate effects on people and the environment; and
- a brief description of the emergency measures taken and of the immediate precautions necessary to prevent recurrence.

Subscribing parties should, as soon as the information is collected, inform the result of their analysis and recommendations using a report form established and kept under review. The names and addresses should also be conveyed of any body which might have relevant information on major accidents and which may be able to advise the competent authorities of other States which have to intervene in the event of such an accident.

States should also be prepared to exchange information on the experience acquired with regard to the prevention of major accidents and the limitation of their consequences. An international register and information reporting system could be maintained that records details of major accidents which have occurred within the territory of individual States. This could serve the purpose of providing:

- rapid dissemination of the information supplied by States among all competent authorities;

- the distribution to all authorities concerned of an analysis of the causes of major accidents and the lessons learned from them;

- the supply of information to competent authorities on relevant preventive measures; and

- the provision of information on organizations able to provide advice or relevant information on the occurrence, prevention and mitigation of major accidents.

The register and information system should contain at least the following information:

- analysis of the causes of the accidents
- lessons learned from the accidents;
- preventive measures necessary to prevent a recurrence.

Access to the register and information system should be open to government departments national authorities, industry or trade associations, trade unions, non-governmental organizations and public interest groups involved with protection of the environment and other international or research organizations working in the field.

States should ensure, in the interests of transparency, that the competent authorities are required to make information received available to anyone who demonstrates reasonable legitimacy. Information obtained by the authorities may, where national provisions so require, be kept confidential if it calls into question any of the following concerns:

- the confidentiality of the deliberations of the competent authorities;

- the confidentiality of international relations and national defense;
- matters of public security;
- the confidentiality of preliminary investigation proceedings or of current legal proceedings;
- commercial and industrial secrets, including intellectual property;
- personal data;
- data supplied by a third party if that party requires that they be kept confidential.

Certification and licensing issues

Without prejudice to the operator's responsibilities, public licensing or regulatory agencies should prohibit the use of any establishment, installation or storage facility where the measures taken by the operator for the prevention and mitigation of major accidents are seriously deficient. They should prohibit the use if the operator has not submitted the notification, reports or other information required within specified time periods. Operators should however, have the opportunity to appeal against a prohibition order by a competent authority to an appropriate body determined by national law and procedures.

For an effective licensing regime to be maintained, it is essential that the competent authorities organize a system of inspections, or other measures of control appropriate to the specific type of establishment. Inspections or other control measures should be sufficient for a planned and systematic examination of the systems being employed at the establishment, whether of a technical, organizational or managerial nature. They should ensure:

- that the operator can demonstrate that he has taken appropriate measures to prevent major accidents, in connection with the various activities involved in the establishment;
- that the operator can demonstrate that he has provided appropriate means for limiting the consequences of major accidents, on-site and off-site;
- that the data and information contained in the safety report, or any other report submitted, truly and completely reflects the conditions in the establishment; and
- that the program should entail at least one on-site inspection made by the competent authority every twelve months, unless the competent authority has established an alternative program of inspections based upon a systematic appraisal of major accident hazards of the particular establishment concerned.

Following each inspection, a report should be prepared by the competent authority. Where necessary, every inspection that is conducted should be followed-up to ensure compliance by the management of the establishment. This may include the need for the competent authority to require the operator to provide any additional information necessary to allow the authority fully to assess the possibility of a major accident and to determine the scope of possible increased probability and/or aggravation of major accidents, or to permit the preparation of an external emergency plan, etc. Additionally, it may require that substances be taken into account which, due to their physical form, particular conditions or location, may require additional consideration.

Preparedness

Internal emergency plans should contain names or positions of persons authorized to set emergency procedures in motion and the person in charge of coordinating the on-site activities. People with responsibility for liaising with the authority responsible for the external emergency plan should also be indicated. For foreseeable conditions or events which could be significant in bringing about a major accident, a description of action necessary to control events should be cited. This would include a description of the safety equipment and technical resources available. Arrangements for limiting the risks to people on-site, including how warnings are to be given and the actions which people are expected to take. Arrangements need to be made for providing early warning of the incident to the authority responsible for setting the external emergency plan in motion. Hence, the type of information which should be contained in an initial warning and the arrangements for the provision of more

detailed information is essential, as it becomes available. Arrangements for training staff in the duties they will be expected to perform, are essential, should be coordinated with off-site emergency services.

External emergency plans with names or positions of persons authorized to set emergency procedures in motion and of persons authorized to take charge of and coordinate off-site action Arrangements for receiving early warning of incidents, and alert and call-out procedures. Arrangements for coordinating resources necessary to implement the external emergency plan. Arrangements for providing assistance with on-site mitigatory action. Arrangements for off-site mitigatory action. Arrangements for providing the public with specific information relating to the accident and the behavior which it should adopt. Arrangements for the provision of information to the emergency services of other Member States in the event of a major accident with possible transboundary consequences.

The identification of training needs of such personnel and the provision of the training so identified. The involvement of employees and, where appropriate, subcontractors; identification and evaluation of major hazards- adoption and implementation of procedures for systematically identifying major hazards arising from normal and abnormal operation and the assessment of their likelihood and severity.

The following practices are important preparedness measures that should be implicit in any early warning and preparedness strategy:

- operational control: adoption and implementation of procedures and instructions for safe operation, including maintenance, of plant, processes, equipment and temporary stoppages;
- management of change: adoption and implementation of procedures for planning modifications to, or the design of new installations, processes or storage facilities;
- planning for emergencies: adoption and implementation of procedures to identify foreseeable emergencies by systematic analysis and to prepare, test and review emergency plans to respond to such emergencies;
- monitoring performance: adoption and implementation of procedures for the ongoing assessment of compliance with the objectives set by the operator's major accident prevention policy and safety management system, and the mechanisms for investigation and taking corrective action in case of non-compliance; and
- audit and review: adoption and implementation of procedures for periodic systematic assessment of the major accident prevention policy and the effectiveness and suitability of the safety management system, including the documented review of performance of the policy and safety management system and its updating by senior management.

These procedures should be applied to the operator's system for reporting major accidents of controlled emergencies conditions, particularly those involving failure of protective measures, and their investigation and follow-up on the basis of lessons learnt;

Relationship to Emergency Relief Actions

The public should be informed by the name of the operator and address of the establishment. Identification, by position held, of the person giving the information. Confirmation that the establishment is subject to the and that the safety report has been submitted to the competent authority. An explanation in simple terms of the activity or activities undertaken at the establishment. The common names or, in the case of dangerous substances the generic names or the general danger classification of the substances and preparations involved at the establishment which could give rise to a major accident, with an indication of their principal dangerous characteristics. General information relating to the nature of the major accident hazards, including their potential effects on the population and the environment.

Adequate information on how the population concerned will be warned and kept informed in the event of a major accident. Adequate information on the actions the population concerned should take, and on the behavior they should adopt, in the event of a major accident. Confirmation that the operator is required to make adequate arrangements on site, in particular liaison with the emergency services, to deal with major accidents and to minimize their effects. A reference to the external emergency plan drawn up to cope with any off-site effects from an accident. This should include advice to cooperate with any instructions or requests from the emergency services at the time of an accident. Details of where further relevant information can be obtained, subject to the requirements of confidentiality laid down in national legislation.

States should ensure that, as soon as practicable following a major accident, the operator should be required, by the most appropriate means, to inform the competent authorities and provide the following information as soon as it becomes available:

- circumstances of the accident,
- dangerous substances involved,
- data available for assessing the effects of the accident on people and the environment,
- emergency measures taken
- inform steps envisaged to alleviate the medium and long term effects of the accident,
- means to prevent any recurrence of such an accident, and
- measures to update the information provided if further investigation reveals additional facts which alter that information or the conclusions drawn.

All subscribing parties should require that competent authorities be designated to

- ensure that any urgent, medium and long term measures which may prove necessary are taken;
- to collect, by inspection, investigation or other appropriate means, the information necessary for a full analysis of the technical, organizational and managerial aspects of the major accident;
- to take appropriate action to ensure that the operator takes any necessary remedial measures; and
- to make recommendations on future preventive measures

For relief actions the activities of authorities and of acting groups must be coordinated. In principle, this demands the following functions be undertaken:

i) Alert system
measurement
data transfer
data interpretation and conclusions
alarm

ii) Action of local authorities, fire brigade etc.
Activities involved, on-site and off-site
evacuation
hospitalization
further measurements

iii) Involvement of regional authorities, groups
Development of disaster relief program
Cooperation of different groups to bring together measurement data of different kind, including chemical specifics, measurements, meteorological data, geographical information systems, modelling of the behavior of substances in the environment
action plan

iv) Involvement of multinational organization levels
Alert of transboundary effects
assistance requirements
actions to reduce immediate effects

Incorporate other national, international activities and organizations as the WMO Environmental Emergency Response Activities Programme, structures from the implementation of the IAEA Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

IV. STRUCTURE OF AN EARLY WARNING SYSTEM

Elements of a Warning System for Technological Hazards

Considering the information in the foregoing sections, the essential elements of an early warning system for technological hazards is outlined here. The structure should be distinctive in reflecting the organizational and technical infrastructural elements involved that are pertinent to a specific location and/or set of operational circumstances. In addition, the structure must reflect both the on-site criteria, which relate to internal establishment procedures indicated in contingency preparedness plans, and additional off-site considerations applicable at local, regional, national, and if necessary, international levels of responsibility. The essential elements of a technological hazards warning system include:

An infrastructure to prevent accidents:
Qualification of personnel of the facilities
Training program
Information program
Alarm and alert systems
Quality assurance management
Maintenance works, control functions
Facility design
Material control
Process planning
Risk analysis

Basic infrastructure for alerting systems
Consequence analysis
Pathway analysis
Reaction products under different conditions of accidental release, including weather conditions and reaction products under specific weather conditions
Cooperation plans with off-site groups (fire brigade, ambulance, hospitals, specialized equipment providers, transportation, chemicals, water cleaning systems)

Infrastructure of detection and response
Detection systems, specification of location
Weather conditions
Prediction modelling and simulation
Communication system, local, regional, cross-boundary
Transport units
Evacuation plans
Emergency operations
Fire brigade, ambulance, warning time, arrival time

Technical and organizational infrastructure
(for control of facilities and licensing procedures).
Organization on site

Local authorities
Regional authorities
National authorities
International cooperation
Conventions
Acting bodies
Data exchange
Emergency assistance
Public information
Modelling
Physical aid, personnel. equipment

Role of Local and Regional Authorities

Taking into account that time is a very important factor for counter measures, the principal task should be to establish systems which can act very quickly and adequately. It is thought that complicated decision-making systems on levels, where no practical connection is given should be avoided so as not to interfere in the local actions being taken.

A contamination that is treated in a quick and appropriate way will not pose a national or international problem. The same contamination which is not treated because of complicated responsibility concepts, where the information has to go back and forth for decision-making, could lead to an environmental disaster.

Concepts should therefore foresee that immediate actions are identified as the responsibility of local organizations and that they are provided with the necessary equipment and information. The information is also going to regional authorities where decisions should be taken about the involvement, if necessary, of additional groups, experts, or equipment which is not available at the local level. All of these details, together with the information about decisions, should reach the national level of responsibility, as it is there, where decisions would be taken about any international information or involvement, as when transboundary effects are expected. This will also include any requests for international assistance deemed to be necessary, such as the provision of material, experts, equipment etc.

The role of the local authorities and of local response groups should be supported by higher levels of responsibility. They should have access to the information which are necessary for a disaster relief plan and for immediate actions. They must know about possible hazards, potential damage (obtained through prior risk analysis). Associated raining concepts have to be based on actual scenario analysis which local capabilities can relate to. In this respect there is need for familiarity and information about hazardous substances, concentrations, velocities of transport means (water, air), direction, different meteorological parameters. Fortunately, much of this information is now easily available in portable form through universally accessible databases or by means of other modern forms of communication and information technology. Furthermore, the most suitable methods of communications must be taken into account, from the initial sounding of an alarm, through the different levels of actions, as well as extending important current, and accurate, information to the public, taking into account existing communication systems and reaction time.

The nationally responsible authority should not interfere in the immediate local actions which can be best prepared based on the information provided by the operator to the authorities. The national authority responsible should also keep all necessary contacts, coordinate additional help, all actions and independent on the national level. For greatest effectiveness, this must be based on concepts which have been developed earlier, maintained to reflect current situations or designated authorities and contact information, approved by, and known to, all authorities concerned.

In the case of an accidental release of substances which could harm people and the environment the fact of the release will be known. Measurements in the environment will give a rough estimation of the concentration of substances, the connection of these data with meteorological data based on

specific situations, as temperature, humidity, wind velocity, direction and specific data from the accident will be used for the necessary decisions. These assessments will take into account release paths, substances released by fire, explosion, pipe rupture, etc. These will help to establish a model of the amount of material released, the direction, form of the substances, and will therefore facilitate first relief actions.

More specific information about the details of contamination for specific actions can be gained by automatic detection systems. Such systems consist of mobile detection units with specific equipment. Theses units also can be connected via telephone or radio to the collection unit. The cyclic information processing is recorded on a Geographic Information System which can then provide an overlay of meteorological, population density, or other relevant data so that measures for action, evacuation, prediction of concentrations can be estimated. This can greatly assist the decision-making processes. These information systems can be connected to national or international data systems for use in either real time analysis and application or for subsequent *post mortem* analysis from the accumulated data received during the course of the event.

International Efforts for Disaster Prevention and Relief

There are many examples of international effort for disaster prevention, mitigation and early warning and relief. The IAEA conventions have been cited. Another is the Open Partial Agreement of the EUR-OPA Major Hazards Agreement to which twenty-one States have acceded to its agreements. This important initiative has the main aim of establishing closer cooperation between Member States in a multi-disciplinary context to ensure better prevention, protection and organization of relief in the event of major natural or technological disasters. The Commission of the European Community, UNESCO, WHO and the United Nations Department of Humanitarian Affairs participate in the Agreement. The International Federation of Red Cross and Red Crescent Societies, similarly, is associated in its work. The Agreement includes also the European Early Warning System. Within the United Nations, the Joint UNEP/DHA Environment Unit has been in operation since 1994, pursuing activities in the field of coordinated sharing of preparedness and response information, and the promotion of improved international response capabilities.

Many organizations deal in the course of their respective mandates, interests and abilities with issues related to technological hazards. Clearly, each organization has its own existing structures. Hence, for any organization that may be tasked with early warning responsibilities in the field, the activities and responsibilities of the existing national and international structures should be taken into account. They include the following organizations:

United Nations Agencies and Departments

- UN Department of Humanitarian Affairs DHA (renamed the Office for the Coordination of Humanitarian Affairs OCHA), including The Joint UNEP/DHA-OCHA Environment Unit
- The Regional United Nations Economic Commissions for Europe, Africa, Latin America, Asia and the Pacific ECE, ECA, ECLAC, ESCAP
- United Nations Development Programme UNDP
- United Nations Conference on Trade and Development UNCTAD
- UN Industrial Development Organization UNIDO
- UN Environment Programme UNEP, including the specific UNEP bodies:
  - Industry and Environment Programme Activity Centre IE/PAC
  - Awareness and Preparedness at the Local Level APELL
  - The Global Resources Information Database GRID
  - The Oceans and Coastal Areas Programme Activity Centre OCA/PAC
  - Earthwatch
  - UNEP Regional Offices
  - Secretariat of the Basel Convention on the Transboundary Movements of Hazardous Wastes

- The International Register of Potentially Toxic Chemicals IRPTC
- The International Maritime Organisation (IMO)
- World Health Organisation WHO
- Food and Agricultural Organisation FAO
- International Atomic Energy Agency IAEA

Other International Bodies

- European Commission Bodies
- Organization for Economic Cooperation and Development OECD

Non-Governmental Organizations

- Verification Technology Information centre, VERIC, London, U.K.
- Science Application International Corporation, SAIC, Virginia, U.S.A.
- Conseil Européen de l`Industrie Chimique, CEFIC, Brussels

National Agencies and Authorities

- Existing national early warning systems
- Existing models of data communication on bilateral basis
- Existing national, regional and local catastrophe management systems (military equipment and organizations, police, fire brigade, ambulance, hospitals)

International Databases for Hazardous Substances

For communication and international assistance, common databases are necessary. For hazardous substances databases from other international conventions can be used. In the case of chemicals use could be made of the scheduled chemicals of the Annex in the Convention for the Prohibition of Chemical Weapons.

Other databases also exist, as for example, the database utilized in the AEWS system. It is known as the "BIG" Software, and it is available on CD-ROM (in English, French, Spanish, Portuguese, German, Dutch, Italian.) And is updated annually. This product of the Braandweer-Informatiecentrum Gvaarlijke Stoffen, Schoolstraat 43 A, B-2440 Geel, Belgium, is a database of more than 8000 substances, corresponding with more than 170,000 product names and it provides the chemical, physical and toxicological characteristics about polluting agents. The database includes basic substance characteristics (identification, description, danger classification etc.) and specific substance characteristics such as ecotoxicological values. It provides a product information file on the following characteristics:

- overview
- identification
- nature of the hazard
- emergency response
- properties
- toxicology
- ecology
- technical data
- material-handling
- transport regulations
- labelling

The database contains any UN identification number assigned by experts, an ADR designation (Accord européen relatif au transport international des marchandises dangereuses par route), EEC

number, composed of nine digits, CAS number of nine digits and two hyphens (Chemical Abstracts Service no.), as well as a Kemler hazard identification code of three digits and one character.

Example of a Product File Overview in the "BIG" Database

Chlorine, liquefied under pressure
GAS no : 007782-50-5

Description / Physical Properties:
Gas
Green -yellow
Irritating/pungent odor
Slightly soluble in water (0.73 g/l00 ml)

Risks:
Non-combustible
Promotes combustion
Heat may cause pressure rise with explosion of tanks/drums
Literature reports: toxic in contact with skin
Literature reports: toxic by inhalation
On contact with water/moisture : corrosive
Severe irritant to skin
Severe irritant to respiratory organs
Severe irritant to eyes
May cause frostbite
Reacts on exposure to water (moisture) with (some) metals and their compounds
Water pollutant (surface water)

Extinguishing Agents:
Major Fire: water spray, polyvalent foam, BC powder, carbon dioxide

Firefighting Instructions:
Cool tanks/drums with water spray, remove them to safety
Physical explosion risk: cool from behind cover
Do not move the load exposed to heat
After cooling, a persistent risk of physical explosion remains
Take account of toxic firefighting water
Limit, and if possible collect/contain, fire-fighting water

Transportation:

Danger code	266
ADR UN no	1017
UN UN no	1017

Labelling:
R : 23 - 36/37/38
S : (01/02) - 07/09 - 45
LABEL : T
EEC no : 017-001-00-7

V. EXAMPLE OF AN INTERNATIONAL ALERT COMMUNICATIONS SYSTEM (AEWS)

Example of An International Structure and Information Exchange System

The Danube Accident Emergency Warning System (AEWS) can provide a useful example of an international structure and information exchange for pollution control concerning water contamination by industrial sources. This program has been established within the Danube - Environment Programme, in 1991, in Sofia. It provides a draft handbook with operational working conditions of what are called “Principal International Alert Centres” (PIAC). Beside this international handbook oriented toward international warning and communication systems applications, the national PIAC also have national guidelines for their own national warning systems. Their salient contents are outlined below:

Objectives

- Safety measures in the case of accidental releases of substances along the Danube and her tributaries which could lead to water contaminations.
- Exchange of information concerning accidents in these rivers.
- Exchange of information concerning not foreseeable changes in water levels.
- Information exchange and processing concerning contaminants which could have significant influences across borders.

Means of accomplishment

- Localize the source and reason of contamination
- Elimination of the source of danger
- Find responsibilities
- Mitigate the damage
- Prevent further effects and damages
- Inform the public
- Data retention and information processing system for the registration of an incident by the use of standard forms for international warning. The transmission of standard forms is done through satellite communication.
- Registration of institutes and experts
- Logging and reporting of incident related events and actions
- General reporting on incidents and for quarterly or annual reports
- Standard forms:
- Warning of incidents: When the location and the source of a sudden incident that may have a serious transboundary impact are known and an international AEWS message is to be filled out for transmission to downstream countries

Organizational structure

The International Agreement on the Protection of the Danube tasks a secretariat located in Vienna with the following responsibilities:

- Central coordination of the AEWS system
- amendments of the system and of procedures
- Actualization of methods and materials
- Testing programs
- Information programs

To fulfill these tasks each PIAC consists of three separate organizational units, not necessarily on the same site: a communication unit, an expert unit, and a decision unit. The PIAC of the country of disaster origin has to initialize the AEWS procedure and the international alert when either, an incident leads to water contamination with a known source, or when contamination is detected, with an unknown source that must first be detected.

Activities of a PIAC

- Confirmation of an accident information of contamination
- Organizational procedure with the information
- Assessment of accident and consequences
- If cross border movement of contamination could be possible, alert next PIAC
- Decision of measures, information of authorities on the different levels for actions and if necessary on international level.
- Information of the public
- Cataloguing all actions taken
- Taking into account and releasing all information obtained
- Processing
- Decisions regarding end of alert
- Information to the international community of these decisions.
- International communication that can be alerted by national, regional or local authorities or from another national PIAC.

Structured information procedure

- Warning of pollution
- Exchange information concerning contaminations
- Request for information
- Access expert groups to assess the consequences of accidental releases
- Facilitate decisions concerning necessary actions
- Notification of end of alert
- Confirmation

Communication systems of PIACs

- Satellite aided communications
- Information processing system
- Databases hazardous substances
- Danube Basin Alarm Model DBAM (Transport model for contaminations, time and concentrations)

Provision of information

- Purpose of message
- PIAC sending the warning
- Date, name
- Time of incident
- Location of the incident
- Incident type
- Industrial spill
- Ruptured pipe
- Boat accident
- Lorry accident
- Explosion
- Fire
- Sewer overflow

- Others
- Water pollution observed
- Fish deaths
- Water coloration
- Odor
- Floating substances
- Measures taken
- Fire extinguished
- Leakage closed
- Floating screen installed
- Floating substance sucked away
- Boat salvaged
- Lorry salvaged
- Pipe closed
- Others
- Substances involved in incident
- Substance name
- Danger code
- Substance identification number
- UN UN - Nr.
- EEC Nr.
- CAS Nr.
- ADR Nr.
- Quantity discharged into water
- Duration of discharge
- Temperature of substances
- Data on water flow and temperature
- River km
- Water level
- Discharge cu.m/sec.
- Flow velocity m/s
- Water temp.
- Date of observation
- Data on concentration in water of substances causing the pollution
- Additional information

Following the end of an alert

- Substances removed
- Pollution moved to downstream country
- Concentration below threshold
- False alert

VI. RECOMMENDATIONS

Given the growth in international risk factors and the potential human, environmental, and material costs of consequences there is a priority need to tasking an existing international organization with the issues of ensuring early warning systems capabilities for technological hazard on a global basis. Priority tasks in relating early warning capabilities to preventing technological disasters should include the following actions:

i) Existing conventions, agreements, guidelines, regulations and laws should be the basis for a global capability pertaining to early warning systems for technological hazards. A survey should be

done regarding questions of appropriate interfaces between information systems, data exchange and measures taken, when bilateral problems are involved.

ii) The installation, or designation of an already-existing a global network of communication, information exchange and coordinated action arising from existing organizations and cooperation with existing organizations and institutions.

iii) Define necessary future work, this should include the continuous review of technological developments with the aim to identify possible fields of actions.

iv) Establish criteria for the global notification of an accident to be accomplished through a designated organization.

v) Make use of existing regulations, guidelines and structures and harmonize these activities for a global application.

vi) Special emphasis should be directed to accident prevention (including on-site measures), hazard detection, prediction, communication, decision-making, and action.

vii) The use, processing or gathering of global data to identify possible priority needs for action.

viii) Identify necessities of specific measurements for certain industries, technological areas such as production, releases to the environment, post consumer product phases, and the related technical processes involved.

ix) Identify necessities for the development of measurement of risk criteria for specific substances.

x) Enhance the development of methods for the identification, estimation, comparative assessment and management of risks of industrial processes (regular activities and accidents) and of products.

xi) Enhance the development of industrial processes and techniques which reduce the risks to men and environment; the development and/or improvement of both preventive and remedial technologies.

xii) Enhance the dissemination and the improvement of exposure assessment methods for hazards to health from chemicals in the environment (Including methods for exposure prediction and for early indicators of exposure)

xiii) Enhance the development of validation methods of health effect assessment methodologies with emphasis on early indicators of adverse effects resulting from exposure to environmental pollutants.

xiv) Strengthen the scientific basis underlying risk assessment of environmental chemicals (particularly genotoxic chemicals).

xv) Develop environmental health impact focal points for air, water and soil quality to establish co-operation in the areas of

- data transfer
- modelling
- practical scenario exercises to address matters of detection, data acquisition and use, decision-making and operational actions using existing structures
- scenario analysis
- communication systems
- data coupling
- measurement nets

- risk analysis
- application of environmental technologies and “best available technology” as a common basis for process and facility design, thereby reducing the demand for facility-specific risk analysis.
- use of satellite environmental data to specify pollution areas in air, land and water.
- encourage technology transfer
- develop technical and organizational guidelines
- harmonize data systems, communication linkages, decision-making processes, and risk levels for alarm, intervention and information exchange
- provide a clearinghouse function for the wide, and inter-disciplinary exchange of information

xvi) Identification of similarities and differences between systems for management and assessment of occupational health, safety and quality to develop criteria for integrated safety management and assessment systems

xvii) Provide guidelines for industrial facilities to prevent accidents, which will include concepts and models for risk analysis, alert plans, data communication, risk assessment and management. The aim is to use or develop methodologies and tools to assess and manage risks evolving from technological hazards, critical analysis of existing safety management systems, industrial best practices, use of accident and precursor data, examination of variations in safety hazard and risk analysis, determination of state-of-the-art chemical accident risk analysis, prevention and management, and related training and the development of appropriate tools for the wide dissemination of knowledge.

xviii) Planning on- and off-site emergency procedures building on analysis of problems of cooperation between organizations.

xix) Provide information by workshops, expert group meetings, cooperation with involved organizations, participation in respective programs and establishing guidelines for technical and organizational procedures.

xx) Provide the basis to ensure necessary logistic frameworks to prevent, mitigate and remedy the consequences of technological hazards exist at national levels and can be applied by designated authorities.

xxi) Ensure that the necessary infrastructure in equipment, personnel and materials based on commonly agreed requirements are available and usable.

xxii) Ensure that provisions for communication pathways are established for communication from the site of a possible accident to action groups in local, regional and national decision-making levels of responsibility.

xxiii) National authorities should be encouraged to communicate the main provisions of domestic laws, information on their respective management systems and the organization of the establishments, with a view to the prevention of major accidents.

xxiv) Publicize data and information to be included in national emergency plans, including information to be provided to the public, including: plant schemes for the utilization of scheduled chemicals and/or the processes concerned, with regard to their amount, release pathways, proximity to specific elements of the natural environment (rural, urban, lakes, rivers; agriculture, fisheries, etc.), accident level, and established response capacities at plant, local, regional, bilateral, and global levels.

xxv) Anticipate and assess new challenges of potential technological hazards, such as the problem of species being transferred by technical or transportation systems (aircraft, cars, shipment).

xxvi) Anticipate and plan for problems associated with gentechnological production and possible accidental releases into the environment.

xxvii) Consider potential technological hazards associated with abandoned military establishments, installations or storage facilities.

xxviii) Continuous assessment of the transport of dangerous substances and intermediate temporary storage by road, rail, internal waterways, sea or air, outside the establishments including loading and unloading, transportation to and from another means of transport at docks, wharves or marshalling yards, etc. The transport of dangerous substances in pipelines, including pumping stations should also be assessed considering the importance of their transboundary implications.

xxix) Monitor the activities of extractive industries concerned with exploration for, and the exploitation of, minerals in mines and quarries or by means of boreholes; waste and land-fill sites.

xxx) In the case that preventive measures for a major accident fail, then the following information should be provided:

- time, location and nature of accident,
- facility, substances involved,
- cause and foreseeable development relevant to the transboundary effects of materials involved,
- general characteristics of released materials, their physical characteristics, chemical form, quantity, composition, etc.,
- results of environmental monitoring,
- off-site protective measures undertaken or activated, and
- predicted behavior of the released materials over a specified time.

VII. REFERENCES

Provisional Handbook AEWS

BIG database: (BIG software supplied by: Braandweer-Informatiecentrum Gvaarlijke Stoffen, Schoolstraat 43 A, B-2440 Geel, Belgium, Phone: +32 14 58 45 47). BIG (Dutch acronym) has been developed and edited by the Information Centre on Hazardous Substances. The BIG information centre is accessible 24 hours a day.

European Community Directive 96/82/EG. 9 December 1996.

Legal Series No. 14, International Atomic Energy Agency, Vienna 1987

VIII. LIST OF CONTRIBUTORS

Convener and First Author:

Peter Krejsa,
Simulation and International Networks
Austrian Research Centre
A- 2444 Seibersdorf, Austria
Tel: (43-2254)-780-3450
Fax: (43-2254)-780-3452
e-mail: peter.krejsa@arcs.ac.at

Contributors:

Jitka Venneken
European Commission,
Directorate General XII D-1
Rue de la Loi 200
B-1049 Brussels, Belgium
Tel: (32-2)-2906 3024
Fax: (32-2)-2906 3024

Col. Norbert Fürstenhofer
Wilhelm-Kaserne
Vorgartenstr. 223
A-1020 Vienna, Austria
Tel: (43-17)-2761 41000
Fax: (43-17)-2761 17130

F. Latzko
Austrian Chamber of Commerce
Wiedner Hauptstr. 63
A-1040 Vienna, Austria
Tel: (43-1)-501050

E. Tomschik
Austrian Chamber of Commerce
Wiedner Hauptstr. 63
A-1040 Vienna, Austria
Tel: (43-1)-501050

M. Jauzein
Institut de Recherches Hydrologiques
Environment
B.P.286 11 bis, rue Gabriel Péri
F-54515 Vandoeuvre Les Nancy, France
Tel: (33-3)- 8350 3651
Fax: (33-3)-8350 3699
e-mail:mjauzein@irh.fr

B. Bilitewski, Technische Universität Dresden
Technische Universität Dresden
Institut für Abfallwirtschaft und Altlasten
Pratzschwitzer Str. 15
D-01796 Pirna, Germany
Tel: (49-35)-0153 0030
Fax: (49-35)-0153 0022

J. Barton
University of Leeds
Dept. of Civil Engineering
Woodhouse Lane,
Leeds LS2 9JT, U.K.
Tel: (44-113)-233-2278
Fax: (44-113)-233-2243
e-mail:j.r.barton@leeds.ac.uk

J. de la Ferté
OECD Nuclear Energy Agency
12, blvd des Îles
92130 Issy-les-Moulineaux, France
Tel: (33-1)- 4524 1110
e-mail:news.contact@nea.fr